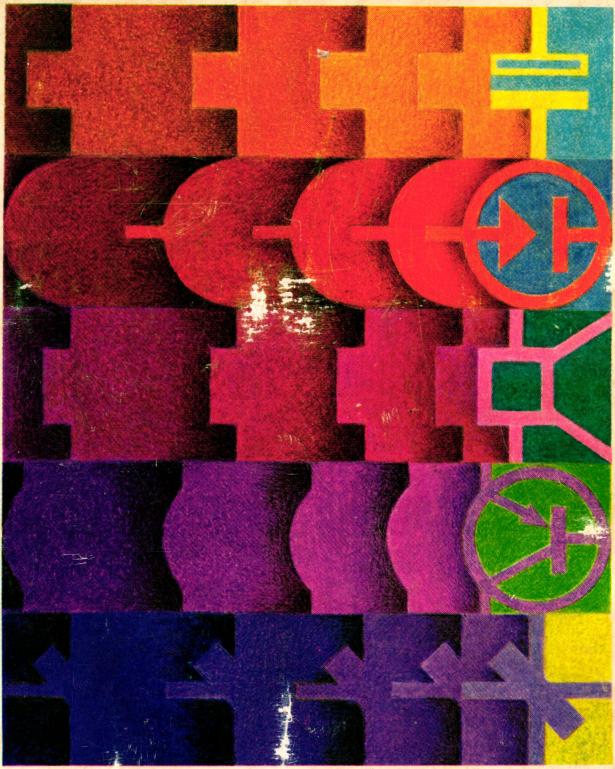
PHILIPS

Electronic components and materials

1973

Pocketbook

electron tubes
semiconductors
integrated circuits
components and materials



POCKETBOOK

1973

electron tubes
semiconductors
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PREFACE

The 1973 edition of the Pocketbook is a completely revised version of the preceding one, containing brief data on the majority of the products of the Electronic Components and Materials Division of NV Philips' Gloeilampenfabrieken.

Unless otherwise specified all dimensions are given in mm. The European projection method is employed in the dimensional drawings.

The Pocketbook does not give information on availability or terms of delivery, and is subject to change without notice. Please regard it as a guide only and, for a comprehensive source of information on electronic components and materials, refer to our Data Handbook system, made up of three series of handbooks, which will be issued periodically.

The three series, identified by the colours noted, each comprise the following parts:

ELECTRON TUBES (BLUE SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1a **Transmitting tubes for communications and Tubes for r.f. heating** **Types PB2/500 ÷ TBW15/125** — **May 1973**

Part 1b **Transmitting tubes for communication**
Tubes for r.f. heating
Amplifier circuit assemblies — **May 1973**

Part 2 **Tubes for microwave equipment** — **February 1972**

Part 3 **Special Quality tubes;**
Miscellaneous devices — **March 1972**

Part 4 **Receiving tubes** — **June 1972**

Part 5 **Cathode-ray tubes; Camera tubes** — **July 1972**

Part 6 **Products for nuclear technology** — **September 1972**

Photodiodes

Photomultiplier tubes
Channel electron multipliers
Scintillators
Photoscintillators
Radiation counter tubes
Semiconductor radiation detectors
Neutron generator tubes
Photo diodes

Part 7 **Gas-filled tubes** — **October 1972**

Voltage stabilizing and reference tubes
Counter, selector, and indicator tubes
Trigger tubes
Switching diodes
Thyratrons
Ignitrons
Industrial rectifying tubes
High-voltage rectifying tubes

Part 8 **T.V. Picture tubes** — **November 1972**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1a Rectifier diodes and thyristors — **December 1972**

- Rectifier diodes
- Voltage regulator diodes
- Transient suppressor diodes
- Thyristors diacs, triacs
- Ignistors
- Rectifier stacks

Part 1b Diodes — **December 1972**

- Small signal germanium diodes
- Small signal silicon diodes
- Special diodes
- Voltage regulator diodes
- Voltage reference diodes
- Tuner diodes

Part 2 Low frequency and deflection transistors — **January 1973**

Part 3 High frequency and switching transistors — **February 1973**

Part 4 Special types — **December 1971**

- Transmitting transistors
- Microwave devices
- Field effect transistors
- Dual transistors
- Microminiature devices for thick- and thin-film circuits
- Photoconductive devices
- Photodiodes
- Phototransistors
- Light emitting diodes
- Infra-red sensitive devices

Part 5 Linear integrated circuits — **February 1972**

Part 6 Digital integrated circuits — **March 1972**

- DTL (FC family)
- DTL/HNIL (FZ family)
- TTL (FJ family)
- TTL (GJ family)
- CML (GH family)
- MOS (FD family)

COMPONENTS AND MATERIALS (GREEN SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 Circuit Blocks, Input/Output Devices, Electro-mechanical Components, Peripheral Devices — **December 1972**

- Circuit blocks 40-Series and CSA70
- Counter modules 50-Series
- Norbits 60-Series, 61- Series
- Circuit blocks 90-Series
- Input/output devices
- Electro-mechanical components
- Peripheral devices

Part 2 Resistors, Capacitors — **December 1971**

- Fixed resistors
- Variable resistors
- Non-linear resistors
- Ceramic capacitors
- Paper capacitors and film capacitors
- Electrolytic capacitors
- Variable capacitors

Part 3 Radio, Audio, Television — **February 1972**

- FM tuners
- Coil assemblies
- Piezoelectric ceramic resonators and filters
- Loudspeakers
- Audio and mains transformers
- Television tuners, aerial input assemblies
- Components for black and white television
- Components for colour television
- Deflection assemblies for camera tubes

Part 4 Magnetic Materials, Piezoelectric Ceramics, Ni Cd cells — **May 1972**

- Ferrites for radio, audio and television
- Small coils and assembling parts
- Ferroxcube potcores and square cores
- Ferroxcube transformer cores
- Piezoelectric ceramics
- Permanent magnet materials
- Cylindrical nickel cadmium cells *)

Part 5 Memory Products, Magnetic Heads, Quartz Crystals, Microwave Devices, Variable Transformers — **August 1972**

- Ferrite memory cores
- Matrix planes, matrix stacks
- Complete memories
- Magnetic heads
- Quartz crystal units, crystal filters
- Isolators, circulators
- Variable mains transformers

Part 6 Electric Motors and Accessories, Timing and Control Devices — **October 1972**

- Small synchronous motors
- Stepper motors
- D.C. motors
- D.C. tachogenerators
- Asynchronous motors
- Indicators for built-in test equipment
- Time indicators, timers, timing motors
- Aircraft electronic clock system

Part 7 Circuit Blocks — **September 1971**

- Circuit blocks 100 kHz Series
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*) These items have been discontinued

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TYPE DESIGNATION CODES AND SYMBOLS FOR ELECTRON TUBES

TYPE DESIGNATION CODE FOR RADIO AND TELEVISION RECEIVING TUBES

This type designation code relates to tubes designed for use primarily in reproducing and recording equipment for domestic applications such as: radio and television receivers, record players, tape recorders and audio amplifiers, home cinema projectors, hearing aids, and similar equipment.

The type designation consists of: TWO OR MORE LETTERS FOLLOWED BY A SERIAL NUMBER

Example and explanation:

First letter indicates the heater voltage or current	Second and subsequent letters indicate the construction and/or application of the tube. (If there is more than one electrode system these letters are placed in alphabetical order.)	Serial number
D ≤1.4 V; series or parallel supply **E** 6.3 V; series or parallel supply **G** miscellaneous; parallel supply **L** 450 mA; series supply **P** 300 mA; series supply **U** 100 mA; series supply The use of letters A (4 V), B (180 mA), C (200 mA), F (12.6 V), K (2 V), V (50 mA), and Y (450 mA) has been discontinued.	**A** diode (excluding rectifiers) **B** double diode with common cathode (excluding rectifiers) **C** triode (excluding power output triodes) **D** power output triode **E** tetrode (excluding power output tetrodes) **F** pentode (excluding power output pentodes) **H** hexode or heptode (of the hexode type) **K** octode or heptode (of the octode type) **L** power output tetrode or power output pentode **M** tuning indicator **Y** half-wave rectifier **Z** full-wave rectifier	The serial number consists of three figures the first figure indicating the type of base:[1]) **1** miscellaneous base types **2** miniature 10-pin base **3** octal base **5** magnoval base **8** noval base **9** miniature 7-pin base The last figure of tetrodes and pentodes (excluding power output tubes) indicates the type of characteristic, as follows: even figure: sharp cutoff characteristic odd figure: variable-mu characteristic

[1]) The use of remaining figures for other base types and the use of serial numbers of one and two figures has been discontinued.

TYPE DESIGNATION CODE FOR PROFESSIONAL RECEIVING-TYPE TUBES

This type designation code relates to professional receiving-type vacuum tubes designed for use primarily in communication equipment, data processing equipment or in other industrial applications.

The type designation consists of: TWO OR MORE LETTERS FOLLOWED BY A SERIAL NUMBER

Example and explanation:

ECC2000

First letter indicates the heater voltage	Second and subsequent letters indicate the construction and/or application of the tube. (If there is more than one electrode system these letters are placed in alphabetical order.)	Serial number
E 6.3 V; parallel or series supply	**A** diode **C** triode (excluding power output triodes) **D** power output triode **E** tetrode (excluding power output tetrodes) **F** pentode (excluding power output pentodes) **H** heptode **L** power output tetrode or power output pentode **M** tuning indicator	The serial number consists of four figures, the first figure indicating the type of base: [1]) **1** miscellaneous base types **2** miniature 10-pin base **3** octal base **5** magnoval base **8** noval base **9** miniature 7-pin base

Serial numbers for prototypes always end in zero, those for variants in one of the figures 1 to 9. The other first figures will be used for new base types as required.

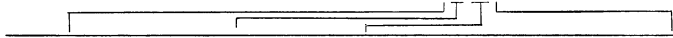
TYPE DESIGNATION CODE FOR CATHODE-RAY TUBES

This type designation code relates to cathode-ray tubes for all applications such as: television and radar display tubes, oscilloscope tubes, monitor tubes and view finders.

The type designation consists of: ONE LETTER FOLLOWED BY TWO GROUPS OF FIGURES JOINED BY A HYPHEN, AND ONE OR TWO LETTERS

Example and explanation:

D10-160GH
A50-120W



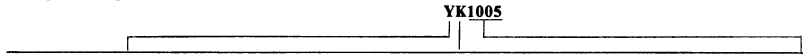
First letter indicates the application and/or construction of tube	First figure or group of figures indicates the screen dimensions	Second figure or group of figures	Final letters indicate the screen properties
A TV display tube for domestic applications **D** Oscilloscope tube, single trace **E** Oscilloscope tube, multiple trace **F** Radar display tube, direct view **L** Display storage tube **M** TV display tube for professional applications, direct view **P** Display tube for professional applications, projection **Q** Flying spot scanner	For rectangular screens the screen diagonal in cm For circular screens the screen diameter in cm	Serial number	The first letter denotes the colour of the fluorescence (or phosphorescence in the case of long or very long persistence screens) according to the regions of the Kelly Chart of colour designations for lights, where applicable: **A** Reddish-purple, purple, bluish-purple **B** Purplish-blue, blue, greenish-blue **D** Blue-green **G** Bluish-green, green, yellowish-green **K** Yellow-green **L** Orange, orange-pink **R** Reddish-orange, red, pink, purplish-pink, purplish-red, red-purple **Y** Greenish-yellow, yellow, yellowish-orange **W** indicates the "standard white" television display tube phosphor **X** indicates tri-colour screens The second letter is a serial letter to denote other specific differences in screen properties. Word description of persistence (Time to decay to 10 % of initial light output) less than 1 μs — very short 1 μs to 10 μs — short 10 μs to 1000 μs — medium short 1 ms to 100 ms — medium 100 ms to 1 s — long more than 1 s — very long

TYPE DESIGNATION CODE FOR PROFESSIONAL TUBES

This type designation code relates to tubes designated for use primarily in radio or television transmitting equipment, in navigation or communication equipment or in other industrial applications.

The type designation consists of: TWO LETTERS FOLLOWED BY A SERIAL NUMBER

Example and explanation:



First letter indicates the category	Second letter indicates the construction and/or application	Serial number
X Tubes employing photosensitive materials **Y** Vacuum tubes for transmitting, microwave or industrial applications **Z** Gasfilled tubes (except tubes employing photosensitive material)	**A** diode **C** trigger tube **D** triode (including double triodes) **G** miscellaneous **H** travelling wave tube **J** magnetron **K** klystron **L** tetrode or pentode (including double tetrodes or double pentodes) **M** cold cathode indicator or counter tube **P** photomultiplier tube, radiation counter tube **Q** camera tube **T** thyratron **X** ignitron, image intensifier or image converter **Y** rectifier **Z** voltage stabiliser	The serial number consists of four figures. Serial numbers for prototypes always end in zero, those for variants in one of the figures 1 to 9.

GROUPS OF LETTERS ALLOCATED TO EXISTING PHOSPHORS

Designation		*E.I.A. number*	*Colour*		*Persistence* (10%)
New	*Old*		*Fluorescence*	*Phosphorescence*	
BA	C		purplish blue		very short
BC	V		purplish blue		killed
BE	B	P11	blue	blue	medium short
BF	U		purplish blue		medium short
GE	K	P24	green	green	short
GH	H	P31	green	green	medium short
GJ	G	P1	yellowish green	yellowish green	medium
GK	G [1])		yellowish green	yellowish green	medium
GL	N	P2	yellowish green	yellowish green	medium short
GM	P	P7	purplish blue	yellowish green	long
GP		P2	bluish green	green	medium short
GR		P39	green	green	long
GU			white	white	very short
LA	D		orange	orange	medium
LB	E		orange	orange	long
LC	F		orange	orange	very long
LD	L	P33	orange	orange	very long
W	W	P4	white		
X	X	P22	tri-colour screen		
YA	Y		yellowish orange	yellowish orange	medium

[1]) Used in projection tubes

CATHODE-RAY TUBES (Old system)

The type number consists of two capital letters followed by two sets of figures (e.g. DG13-2, MW31-16).

First letter: indicates the method of focusing and deflection.
Second letter: indicates properties of the screen.
First group of figures: indicates dimensions of the screen.
Second group of figures: indicates a serial number.

The key to this system is given in the following tables.

First letter

A — Electrostatic focusing and electromagnetic deflection.
D — Electrostatic focusing and electrostatic deflection in two directions.
M — Electromagnetic focusing and electromagnetic deflection.

Second letter

Indicates the phosphor screen properties.

First group of figures

For round tubes : screen diameter in cm
For rectangular tubes: screen diagonal in cm

Second group in figures

Serial number

TRANSMITTING TUBES (Old system)

The type number consists of two or three capital letters followed by two sets of figures. For some types a group of letters is added (e.g. TAL12/10, DCG4/1000G).

First letter: indicates the tube classification.
Second letter: indicates type of filament or cathode.

First group of figures: indicates operating voltage.
Second group of figures: indicates power.
Added letters: indicate the tube base.

The key to this system is given in the following tables.

First letter

D —Rectifying tube (included grid-controlled tubes)
M—Triode (A.F. amplifying tube or modulator)
P —Pentode
Q —Tetrode
T —Triode (R.F., A.F. or oscillator tube)

For tubes having dual systems two of the above mentioned letters are used (e.g. QQC04/15).

Second letter

(third letter for tubes having dual systems)

A—Directly-heated tungsten filament
B—Directly-heated thoriated tungsten filament
C—Directly-heated oxide-coated filament
E—Indirectly-heated oxide-coated cathode

Third letter

(fourth letter for tubes having dual systems)

G —Mercury-vapour filling
H —Helix or other integral cooler
L —Forced air cooling
W—Water cooling
X —Xenon filling

When the type number does not contain a letter indicating the cooling, the tube is radiation-cooled.

First group of figures

Rectifying tubes: Approx. d.c. output voltage in kilovolts in a threephase half-wave rectifying circuit.
Transmitting tubes: Approx. max. anode voltage in kilovolts.

Second group of figures

Rectifying tubes: Approx. d.c. output power in watts or kilowatts per tube in a three-phase half-wave rectifying circuit.
R.F. tubes: Approx. output power in watts or kilowatts in class C telegraphy.
Modulators: Approx. anode dissipation in watts or kilowatts.

Added letters

B —Cables
E —Medium 7p.-base
ED—Edison base
EG—Goliath base
G —Medium 4p.-base
GB—Jumbo 4p.-base
GS—Super jumbo 4p.-base
N —Medium 5p.-base
P —P-base

PHOTOTUBES AND PHOTOMULTIPLIERS (old system)

The type number consists of two figures followed by two letters (e.g. 90AV).
First figure : indicates the tube base.
Second figure: indicates a serial number.
First letter : indicates the type of cathode.
Second letter : indicates the class of phototube.
Third letter : letter P only for photomultipliers
The key for this system is given in the following tables.

First figure

2—Loctal 8p.-base
3—Octal 8p.-base
5—Special base
8—Noval 9p.-base
9—Miniature 7p.-base

Second figure—Serial number

First letter

A —Caesium-antimony cathode (blue sensitive)
C —Caesium-on-oxidized-silver cathode (red sensitive)
T —Tialkali cathode
U—Caesium-antimony cathode with quartz window

Second letter

G—Gasfilled V—High vacuum

VOLTAGE STABILIZERS (Old system)

The type number consists of a number followed by a capital letter, a figure and in some cases by a second capital letter (e.g. 85A2, 150C1K).

Number: indicates burning voltage.
First letter: indicates the current range.
Figure: indicates a serial number.
Second letter: indicates the tube base.

The key for this system is given in the following tables.

Number

Average burning voltage in volts

First letter

A —max. 10 mA
B —max. 22 mA
C —max. 40 mA
D—max. 100 mA
E —max. 200 mA

Second letter

E —Edison
K—Octal 8p.-base
P —P-base

Figure

Serial number

SYMBOLS

Electrodes

a	Anode
ah	Auxiliary anode
a_{ign}	Ignition anode
d	Anode of detection diode
D	Deflection plate or rod
f	Filament or resistance wire
fc	Filament tap or star point of three star connected filaments
g	Grid
i.c.	Internal connection (not to be connected externally)
k	Cathode
$k_{(i)}$	Input cathode lead of U.H.F. tube
$k_{(o)}$	Output cathode lead of U.H.F. tube
l	Fluorescent screen
m	External conducting coating
n.c.	Tube pin which may be connected externally
pr	Primer (auxiliary electrode of cold cathode tubes to ensure safe triggering)
s	Internal shield
S	Switch
st	Starter or trigger electrode of cold cathode tubes

Electrode systems

D	Diode	*P*	Pentode
H	Hexode or Heptode	*Q*	Tetrode
		T	Triode

Voltages

V_a	Anode voltage
	Burning voltage of voltage stabilizer
ΔV_a	Burning voltage variation of voltage stabilizer in stabilizing range
V_{arms}	A.C. anode voltage (rms value)

$V_{a\text{invp}}$	Peak value of inverse anode voltage
V_{ap}	Peak value of anode voltage
V_{arc}	Arc voltage
V_b	Supply voltage
V_{ba}	Anode supply voltage
V_{bg2}	Supply voltage of second grid
V_{contr}	Voltage range of current regulator
V_d	Anode voltage of detection diode
V_{dinv}	Inverse anode voltage of detection diode
V_{dinvp}	Peak value of inverse anode voltage of detection diode
V_{eff}	RMS value of a voltage
V_{ext}	Extinguishing voltage
V_f	Filament or heater voltage
V_{fwd}	Forward voltage
V_g	Grid voltage
$V_{g(\text{arc})}$	Grid voltage of conducting tube
$V_{g\text{invp}}$	Peak value of inverse grid voltage
V_{gp}	Peak value of grid voltage
V_{GR}	Grid no. 1 voltage for visual extinction of focused raster (grid drive service)
V_i	A.C. input voltage per tube
V_{ign}	Voltage necessary for breakdown to the concerning electrode
V_{invp}	Peak value of inverse voltage
V_k	Voltage between cathode and chassis
V_{kf}	Voltage between cathode and filament
$V_{kf\text{p}}$	Peak value of voltage between cathode and filament
V_{KR}	Cathode voltage for visual extinction of focused raster (cathode drive service)
V_l	Voltage of fluorescent screen
V_m	Maintaining voltage
V_o	A.C. output voltage: d.c. output voltage
V_{osc}	Oscillator voltage
V_{pr}	Primer voltage of a cold cathode tube
V_r	Regulation voltage
V_{res}	Resonator voltage
V_{st}	Starter voltage of a cold cathode tube
V_{tr}	Secondary transformer voltage (without load)

Currents

I_a	Anode current
I_{a_0}	Dark current
$I_{a\max}$	Anode current at full drive
$I_{a\min}$	Anode current without drive
I_{ah}	Auxiliary anode current
I_{ap}	Peak value of anode current
I_b	Supply current
I_{contr}	Current range of voltage stabilizer
I_d	Anode current of detection diode
I_{dp}	Peak value of anode current of detection diode
I_f	Filament current
I_g	Grid current
$I_{g\max}$	Grid current at full drive
$I_{g\min}$	Grid current without drive
I_{gp}	Peak value of grid current
I_k	Cathode current
I_l	Current of fluorescent screen
I_o	D.C. output current per tube
I_{pr}	Primer current of a cold cathode tube
I_{rec}	Recommended current
I_{reg}	Stabilized current of current regulator
I_{st}	Starter current
$I_{st\,\text{transf}}$	Starter current required to initiate the main discharge
I_{surge}	Surge current

Powers

W_a	Anode dissipation
W_g	Grid dissipation
W_{ig}	Driving power
W_o	Output power

Resistances

R_a	External anode resistor; Matching resistance
	Total anode resistance of rectifying tube
$R_{a\sim}$	External a.c. resistance or load resistance in an anode lead
R_{aa}	Load resistance of push-pull amplifier (anode to anode)

$R_{damping}$	Damping resistance
R_{eq}	Equivalent noise resistance
R_E	Resistance of thermo-element
R_f	Resistance of filament
R_g	External resistance between grid and cathode
$R_{g'}$	External resistance between grid and cathode of next tube
R_i	Internal resistance
R_{id}	Internal resistance of detection diode
R_k	Resistance between cathode and chassis
R_{kf}	External resistance between cathode and filament
R_{st}	External resistor in the starter lead of a cold cathode tube
R_t	Total anode resistance of rectifying tube
R_1	External resistance between $+V_b$ and g_2
R_2	External resistance between g_2 and chassis } potentio-
R_3	External resistance between g_2 and k } meter
R_4	External resistance between k and chassis

Capacitances

C_a	Anode to all other elements except control grid
C_{ag}	Anode to grid, all other elements earthed
C_{ak}	Anode to cathode, all other elements earthed
C_{dk}	Anode to cathode of detection diode } all other
C_{x1x2}	Deflection plate x_1 to deflection plate x_2 } elements
C_{y1y2}	Deflection plate y_1 to deflection plate y_2 } earthed
C_{filt}	Input capacitor of smoothing filter
C_g	Grid to all other elements except anode

Miscellaneous

d_{tot}	Total distortion
f	Frequency
F	Noise level
g	Voltage gain per stage
G	Current amplification (Gain)
m	Number of anodes of rectifying tubes
M	Deflection factor
N	Sensitivity
N_a	Luminous anode sensitivity

N_k	Luminous cathode sensitivity
S	Mutual conductance
S_c	Conversion conductance
S_{eff}	Effective slope of oscillator tube
S_o	Mutual conductance of oscillator triode at $V_g = 0$ V and $V_{\text{osc}} = 0$ V
t_{amb}	Ambient temperature
t_{bulb}	Bulb or envelope temperature
t_{Hg}	Temperature of condensed mercury (at the cathode)
t_{rec}	Recommended temperature
T_{av}	Averaging time
T_{dion}	Deionization time
T_{imp}	Pulse duration
T_h	Heating time of tube
T_{ion}	Ionization time
T_{imp}	Pulse time
T_r	Rise time
T_w	Waiting time of a tube = time which has to pass between switching on of the filament (or heater) voltage and switching on of the voltages on the other electrodes
α	Shadow section on fluorescent screen
β	Light sector on a fluorescent screen
η	Efficiency
μ	Gain factor
μ_{g2g1}	Gain factor of grid No. 2 with respect to grid No. 1

GENERAL OPERATIONAL RECOMMENDATIONS RECEIVING TUBES

1. GENERAL

Where deviations from these directives are permissible or necessary, statements to that effect will be made on the relevant data sheets. If applications are considered not referred to in the data sheet of the relevant tube type extra care should be taken with circuit design to avoid that the tube is overloaded due to unfavourable operating conditions.

Users are warned for applying a tube in circuits where use is made of tube characteristics not controlled by the manufacturer. When at a later date batches of tubes are delivered which show different values for these characteristics this may result in unsatisfactory performance of the equipment.

2. LIMITING VALUES

2.1 Limiting values are in accordance with the applicable rating system as defined by I.E.C. publication 134.

Reference may be made to one of the following 3 rating systems.

2.1.1 *Absolute maximum rating system.* Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment components spread and variation, equipment control adjustment, load variations, signal variation, environmental conditions, and spread or variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

2.1.2 *Design-maximum rating system.* Design-maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device* of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions. These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design-maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

2.1.3 *Design-centre rating system.* Design-centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device* of a specified type as defined by its published data, and should not be exceeded under average conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply-voltage variation, equipment component spread and variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations or spread in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design-centre value for the intended service is exceeded with a bogey electronic device* in equipment operating at the stated normal supply-voltage.

2.2 If the tube data specify limiting values according to more than one rating system the circuit has to be designed so that none of these limiting values is exceeded under the relevant conditions.

*Note**. A bogey tube is a tube whose characteristics have the published nominal values for the type. A bogey tube for any particular application can be obtained by considering only those characteristics which are directly related to the application.

2.3 In addition to the limiting values given in the individual data sheets the directives in the following paragraphs should be observed.

3. FLOATING ELECTRODES

All tube electrodes should have a d.c. connection to the cathode (no floating electrodes).

4. ELECTRODE CURRENT

The limiting values I_a, I_{g2}, I_k etc. are the d.c. components of the electrode currents averaged over any 50 ms period.

5. ELECTRODE DISSIPATION

The limiting values W_a, W_{g2} etc. are the average values, obtained by averaging over any 1 s period.

6. HEATER CIRCUIT

Any deviation from the nominal heater voltage (in case of parallel connection) or from the nominal heater current (in case of series connection) has a detrimental effect on tube performance and life, and should therefore be kept at a minimum. Such deviations may be caused by:

a) Mains voltage fluctuations.
b) Spread in the characteristics of components such as transformers, resistors, capacitors etc.

Designers of heater circuits are strongly recommended to bear this in mind when dealing with equipment to be used in areas where the actual mains voltage is likely to differ from the nominal value.

7. NO CONNECTIONS SHOULD BE MADE TO A PIN MARKED I.C.

REPLACEMENT GUIDE FOR ELECTRON TUBES

INTRODUCTION

The guide presents a survey of all types of electron tubes for which our tubes can be used as replacements.

Types for which a suitable replacement is sought are listed alphabetically and numerically in the first column; where applicable, alternative CV numbers of our corresponding tubes are listed in the second column; and the type numbers of our equivalent or replacement tubes in the third column.

Type numbers printed between brackets in the third column are near equivalents of the types to be replaced; however, in almost all cases the circuits in which they are to be fitted can be adapted to make use of them as replacements.

Replacements for obsolete types are also listed. In many cases the recommended replacement can be used without modifying the circuit or equipment in which it is to be fitted. In some cases, however, it may be necessary to change or rewire the socket, fit an adapter, or alter the circuit slightly. Where an obsolete triode is to be replaced by a pentode, the latter can be used in triode connection.

The fact that a tube is listed does not imply that it can always be supplied.

TYPE DESIGNATION CODES, COLOUR CODING, RATING SYSTEMS AND LETTER SYMBOLS FOR SEMICONDUCTORS AND INTEGRATED CIRCUITS

TYPE DESIGNATION CODE FOR SEMICONDUCTOR DEVICES

GENERAL

This type designation code applies to discrete devices either with or without junctions, and to multiple devices[1])
The type designation consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

The first letter distinguishes between junction and non-junction devices and gives an indication of the material

A. Devices with one or more junctions, using material with a band gap of 0.6 to 1.0 eV, such as germanium
B. Devices with one or more junctions, using material with a band gap of 1.0 to 1.3 eV, such as silicon
C. Devices with one or more junctions, using material with a band gap of 1.3 eV and more, such as gallium arsenide
D. Devices with one or more junctions, using material with a band gap of less than 0.6 eV, such as indium antimonide
R. Devices without junction, using materials such as those employed in Hall generators and photoconductive cells

---

[1]) A multiple device is defined as a combination of similar or dissimilar active devices, contained in a common encapsulation that cannot be dismantled, and of which all electrodes of the individual devices are accessible from the outside.
Multiples of similar devices as well as multiples consisting of a main device and an auxiliary device are designated according to the code for discrete devices described above.
Multiples of dissimilar devices of other nature are designated by the second letter G.

The second letter indicates primarily the main application respectively main application and construction if a further differentiation is essential

A. Detection diode, high speed diode, mixer diode
B. Variable capacitance diode
C. Transistor for a.f. applications ($R_{th\ j\text{-}mb} > 15°C/W$)
D. Power transistor for a.f. applications ($R_{th\ j\text{-}mb} \leqslant 15°C/W$)
E. Tunnel diode
F. Transistor for r.f. applications ($R_{rh\ j\text{-}mb} > 15°C/W$)
G. Multiple of dissimilar devices
H. Field probe
K. Hall generator in an open magnetic circuit, e.g. magnetogram or signal probe
L. Power transistor for r.f. applications ($R_{th\ j\text{-}mb} \leqslant 15°C/W$)
M. Hall generator in a closed electrically energised magnetic circuit, e.g. Hall modulator or multiplier
N. Photocoupler
P. Radiation sensitive device
Q. Radiation generating device
R. Electrically triggered controlling and switching device having a breakdown characteristic ($R_{th\ j\text{-}mb} > 15°C/W$)
S. Transistor for switching applications ($R_{th\ j\text{-}mb} > 15°C/W$)
T. Electrically, or by means of light, triggered controlling and switching power device having a breakdown characteristic ($R_{th\ j\text{-}mb} \leqslant 15°C/W$)
U. Power transistor for switching applications ($R_{th\ j\text{-}mb} \leqslant 15°C/W$)
X. Multiplier diode, e.g. varactor, step recovery diode
Y. Rectifying diode, booster diode, efficiency diode
Z. Voltage reference or voltage regulator diode

The serial number consists of:

Three figures for semiconductor devices designed for use primarily in consumer goods
One letter and two figures for semiconductor devices designed for use primarily in professional equipment

A *version letter* can be used, for instance, for a diode with up-rated voltage, for a sub-division of a transistor type in different gain ranges, a low noise version of an existing transistor and for a diode, transistor, or thyristor with minor mechanical differences, such as finish of the leads, length of the leads etc. The letters never have a fixed meaning, the only exception being the letter R.

TYPE DESIGNATION FOR SEMICONDUCTOR DEVICES FORMING A RANGE OF VARIANTS

The type designation of a range of variants of:
1. voltage reference or voltage regulator diodes
2. rectifying diodes
3. thyristors
4. radiation detectors

distinctly belonging to one basic type may be qualified by a suffix part which is clearly separated from the basic part by a dash (–).

The basic part being the same for the whole range, is in accordance with the designation code for discrete devices.

The suffix part consists of:

1. *for voltage reference or voltage regulator diodes*
   one letter followed by the typical zener voltage and where appropriate the letter R[1])
   The first letter indicates the nominal tolerance of the zener voltage in %.
   A = 1 %; B = 2 %; C = 5 %; D = 10 %; E = 15 %
   The typical zener voltage is related to the nominal current rating for the whole range. The letter V is used to denote the decimal point when this occurs.
2. *for rectifying diodes*
   a number and where appropriate the letter R[1])
   The number generally indicates the maximum repetitive peak reverse voltage.
   For controlled avalanche types it indicates the maximum crest working reverse voltage

[1]) The letter R indicates reverse polarity (stud anode). The normal polarity (stud cathode) and symmetrical executions are not specially indicated.

3. *for thyristors*
   a number and where appropriate the letter R [1]) (see foregoing page).
   The number generally indicates either the maximum repetitive peak reverse voltage or the maximum repetitive peak off-state voltage, whichever is lower.
   For controlled avalanche types it indicates the maximum crest working reverse voltage.
4. *for radiation detectors*
   a figure giving the depth of the depletion layer in μm and where appropriate a version letter if there are differences in resolution.

EXAMPLES

BZY88series Range of silicon voltage regulator diodes for industrial applications

BZY88-C9V1 The particular type out of the range with a typical zener voltage of 9.1 V $\pm$ 5%

BYX13-1200 The particular normal polarity type out of the BYX13series with a maximum repetitive peak reverse voltage of 1200 V

OLD SYSTEM

The first letter is always "O", indicating a semiconductor device. *The second (and third) letter(s)* indicate the general class of device.

A - diode or rectifier	C - transistor
AP - photodiode	CP - phototransistor
AZ - zener diode	RP - photoconductive cell

The group of figures is a serial number indicating a particular design or development.

EXAMPLES

OA81	Semiconductor diode
OAZ200	Zener diode
OC72	Transistor

TYPE DESIGNATION FOR SEMICONDUCTOR RECTIFIER STACKS

The type designation consists of:

THREE LETTERS FOLLOWED BY A SERIAL NUMBER

The first 2 *letters* indicate the type of stack:

OS. Denotes a semiconductor rectifier diode stack
OT. Denotes a semiconductor stack in which also thyristors are used

The third letter indicates the type of circuit:

A. Single phase half wave
B. Two phase half wave
C. Three phase half wave (three phase star)
D. Four phase half wave (four phase star)
E. Six phase half wave (six phase star)
F. Three phase double Y with interphase transformer
H. Single phase full wave (single phase bridge)
J. Single phase magnetic amplifier bridge
K. Three phase full wave (three phase bridge)
L. Four phase full wave (four phase bridge)
M. Voltage doubler (half a single phase full wave)
S. Miscellaneous (such as combinations of single diodes and passive components)

The serial number is sometimes followed by a suffix letter for the indication of variants.

COLOUR CODING TYPE NUMBERS FOR WHISKERLESS DIODES

The coloured bands denote either numbers or letters as follows:

colour	*number*	*letter*	*colour*	*number*	*letter*
black	0	not appl	green	5	E
brown	1	A	blue	6	F
red	2	B	violet	7	G
orange	3	C	grey	8	H
yellow	4	D	white	9	J

FOR PRO-ELECTRON TYPE NUMBERS

The letter combination of the type number is identified by the body colour

BA – beige	BAW – light blue	BAY – light red
BAV – light green	BAX – black	

The serial number is indicated by coloured bands (see list above).
The first digit of the number is a broad band at the cathode end.

FOR JEDEC ASSIGNED TYPE NUMBERS (based on EIA-standard RS-236-B of June 1963).

The prefix identification (1N) is not indicated in the coding.
The sequence number is indicated by three or four bands, depending on its length. Zero (black) preceeds two-digit numbers. Any suffix letter is indicated as a fourth or a fifth band.
The first digit of the number is at the cathode end, which is marked by either a double-width band or clearly grouping the bands toward the cathode end.

TYPE DESIGNATION CODE FOR INTEGRATED CIRCUITS

This code applies to networks in non-accessible envelopes, such as integrated circuit devices.
For the purpose of type designation the integrated circuits are divided into four groups:
- digital family circuits i.e. circuits belonging to a family of circuits which are related in their specifications, and primarily designed to be mutually connected;
- digital solitary circuits;
- analogue (linear) type of circuits;
- mixed digital-analogue type of circuits.

The type designations consist of:

THREE LETTERS FOLLOWED BY THREE FIGURES[1])

DIGITAL FAMILY CIRCUITS
The first two letters indicate the family for the digital family circuits.

DIGITAL SOLITARY CIRCUITS
The first letter is "S"
The second letter is used to extend the serial number.

DIGITAL FAMILY AND SOLITARY CIRCUITS
The third letter indicates the circuit function in categories

H Combinatorial circuit
J Bistable or multistable sequential circuit
K Monostable sequential circuit
L Level converter
N Bimetastable or multimetastable sequential circuit
Q Read/write memory circuit
R Read-only memory circuit

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[1]) Sometimes the type designation is followed by a version letter to denote a variant with respect to electrical performance and/or encapsulation.

S Sense amplifier
Y Miscellaneous

ANALOGUE (LINEAR) TYPE CIRCUITS
The first letter is "T"

MIXED DIGITAL/ANALOGUE TYPE CIRCUITS
The first letter is "U"

ANALOGUE AND DIGITAL/ANALOGUE CIRCUITS
The second and third letter are used to extend the serial number.

ALL TYPES
The first two figures represent the serial number.
The third figure indicates the operating ambient temperature range

1 0 to + 70° C or wider
2 − 55 to + 125° C or wider
3 − 10 to + 85° C or wider
4 + 15 to + 55° C or wider
5 − 25 to + 70° C or wider
6 − 40 to + 85° C or wider
0 open

RATING SYSTEMS

ACCORDING TO I.E.C. PUBLICATION 134

1. DEFINITIONS OF TERMS USED

1.1 *Electronic device.* An electronic tube or valve, transistor or other semiconductor device.

Note: This definition excludes inductors, capacitors, resistors and similar components.

1.2 *Characteristic.* A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

1.3 *Bogey electronic device.* An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

1.4 *Rating.* A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Note: Limiting conditions may be either maxima or minima.

1.5 *Rating system.* The set of principles upon which ratings are established and which determine their interpretation.

NOTE. The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

2. ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

3. DESIGN MAXIMUM RATING SYSTEM

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

4. DESIGN CENTRE RATING SYSTEM

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

NOTE. It is common use to apply the Absolute Maximum System in semiconductor published data.

LETTER SYMBOLS FOR SEMICONDUCTOR DEVICES
excluding rectifier diodes and thyristors

This system is based on the Recommendations of the INTERNATIONAL ELECTROTECHNICAL COMMISSION as published in I.E.C. Publication 148.

QUANTITY SYMBOLS

1. Instantaneous values of current, voltage and power, which vary with time are represented by the appropriate lower case letter.

Examples: i, v, p

2. Maximum (peak), average, d.c. and root-mean-square values are represented by the appropriate upper case letter.

Examples: I, V, P

SUBSCRIPTS FOR QUANTITY SYMBOLS

1. Total values are indicated by upper case subscripts.

Examples: I_C, I_{CM}, I_{CAV}, i_C, V_{EB}

2. Values of varying components are indicated by lower case subscripts.

Examples: i_c, I_c, v_{eb}, V_{eb}

3. To distinguish between maximum (peak), average, d.c. and root-mean-square values, the following subscripts are added:
   For maximum (peak) values: M or m
   For average values : AV or av (only if it is necessary to distinguish between d.c. and average)
   For d.c. values : no additional subscript
   For root-mean-square values: (rms)

Examples: I_C, I_{cm}, I_{CAV}, $I_{c(rms)}$, $I_{C(RMS)}$

4. List of subscripts (examples, see figure 1)

A, *a*	= Anode terminal
K, *k*	= Cathode terminal
E, *e*	= Emitter terminal
B, *b*	= Base terminal
C, *c*	= Collector terminal
(BR)	= Break-down
X, *x*	= Specified circuit
M, m	= Maximum (peak) value
AV, av	= Average value
(RMS), (rms)	= R.M.S. value
F, *f*	= Forward
R, *r*	= As first subscript: Reverse. As second subscript: Repetitive
O	= As third subscript: The terminal not mentioned is open circuited
S	= As second subscript: Non repetitive As third subscript: Short circuit between the terminal not mentioned and the reference terminal
Z	= Zener. (Replaces *R* to indicate the actual zener voltage, current or power of voltage reference or voltage regulator diodes)

5. Examples of the application of the rules:
Figure 1 represents a transistor collector current, consisting of a direct current and a signal, as a function of time.

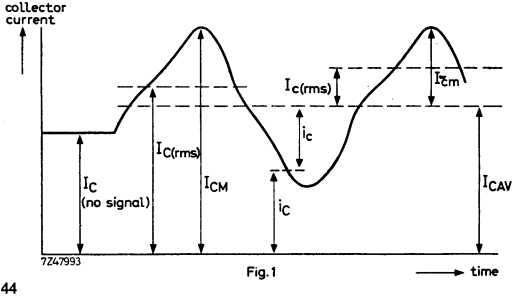


Fig.1

CONVENTIONS FOR SUBSCRIPT SEQUENCE

1. *Currents*

For transistors the first subscript indicates the terminal carrying the current (conventional current flow from the external circuit into the terminal is positive).

For diodes a forward current (conventional current flow into the anode terminal) is represented by the subscript F or f; a reverse current (conventional current flow out of the anode terminal) is represented by the subscript R or r.

2. *Voltages*

For transistors normally, two subscripts are used to indicate the points between which the voltage is measured. The first subscript indicates one terminal point and the second the reference terminal.

Where there is no possibility of confusion, the second subscript may be omitted.

For diodes a forward voltage (anode positive with respect to cathode) is represented by the subscript F or f and a reverse voltage (anode negative with respect to cathode) by the subscript R or r.

3. *Supply voltages*

Supply voltages may be indicated by repeating the terminal subscript.

Examples: V_{EE}, V_{CC}, V_{BB}

The reference terminal may then be indicated by a third subscript.

Examples: V_{EEB}, V_{CCB}, V_{BBC}

4. In devices having more than one terminal of the same type, the terminal subscripts are modified by adding a number following the subscript and on the same line.

Example: $V_{B2\text{-}E}$ voltage between second base and emitter

In multiple unit devices, the terminal subscripts are modified by a number preceding the terminal subscripts:

Example: $V_{1B\text{-}2B}$ voltage between the base of the first unit and that of the second one.

ELECTRICAL PARAMETER SYMBOLS

1. The values of four pole matrix parameters or other resistances, impedances, admittances, etc... inherent in the device, are represented by the lower case symbol with the appropriate subscripts.

Examples: h_{ib}, z_{fb}, y_{oc}, h_{FE}

2. The four pole matrix parameters of external circuits and of circuits in which the device forms only a part are represented by the upper case symbols with the appropriate subscripts.

Examples: H_i, Z_o, H_F, Y_R

SUBSCRIPTS FOR PARAMETER SYMBOLS

1. The static values of parameters are indicated by upper case subscripts.

Examples: h_{IB}, h_{FE}

Note: The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

2. The small signal values of parameters are indicated by lower case subscripts.

Examples: h_{ib}, z_{ob}

3. The first subscript, in matrix notation identifies the element of the four pole matrix.

i (for 11) = input	f (for 21) = forward transfer
o (for 22) = output	r (for 12) = reverse transfer

Examples: $V_1 = h_i I_1 + h_r V_2$
$I_2 = h_f I_1 + h_o V_2$

Notes [1]) The voltage and current symbols in matrix notation are indicated by a single digit subscript.
The subscript 1 = input; the subscript 2 = output
[2]) The voltages and currents in these equations may be complex quantities.

4. The second subscript identifies the circuit configuration.

e = common emitter	c = common collector
b = common base	j = common terminal, general

Examples: (common base) $I_1 = y_{ib} V_{1b} + y_{rb} V_{2b}$
$I_2 = y_{fb} V_{1b} + y_{ob} V_{2b}$

When the common terminal is understood, the second subscript may be omitted.

5. If it is necessary to distinguish between real and imaginary parts of the four pole parameters, the following notations may be used.

$\mathrm{Re}(h_{ib})$ etc... for the real part
$\mathrm{Im}(h_{ib})$ etc... for the imaginary part

LIST OF LETTER SYMBOLS
excluding rectifier diodes and thyristors

Letter symbol	*Definition*
b_{ib}, b_{ie}, b_{ob}, b_{oe}	See *y* parameters
C_c [1])	Collector capacitance (emitter open-circuited to a.c. and d.c.)
C_d [1])	Diode capacitance
C_e [1])	Emitter capacitance (collector open-circuited to a.c. and d.c.)
C_{ib}, C_{ie}, C_{ob}, C_{oe} [1])	See *y* parameters
d	Distortion
F	Noise figure
f	Frequency
F_c	Conversion noise figure
f_{hfb}, f_{hfe}, f_{yfe}	Cut-off frequency (frequency at which the parameter indicated by the subscript is 0.7 of its low frequency value)
f_T	Transition frequency (gain-bandwidth product)
g_{ie}, g_{ib}, g_{oe}, g_{ob}	See *y* parameters
G_p	Power gain
G_S	Source conductance
G_{tr}	Transducer gain
G_{UM}	Maximum unilateralised power gain
h_{FB}, h_{FC}, h_{FE}	Static value of the forward current transfer ratio or d.c. current gain (output voltage held constant)
h_{fb}, h_{fc}, h_{fe}	Small signal value of the forward current transfer ratio or small signal current gain (output short-circuited to a.c.)

[1]) As an exception to the general rule for electrical parameters capacitances are represented by the upper-case letter.

Letter symbol	*Definition*
h_{IB}, h_{IC}, h_{IE}	Static value of the input resistance (output voltage held constant)
h_{ib}, h_{ic}, h_{ie}	Small signal value of the input impedance (output short-circuited to a.c.)
h_{OB}, h_{OC}, h_{OE}	Static value of the output conductance (input current held constant)
h_{ob}, h_{oc}, h_{oe}	Small signal value of the output admittance (input open-circuited to a.c.)
h_{RB}, h_{RC}, h_{RE}	Static value of the reverse voltage transfer ratio (input current held constant)
h_{rb}, h_{rc}, h_{re}	Small signal value of the reverse voltage transfer ratio (input open-circuited to a.c.)
I_B, I_C, I_E	Total d.c. (or average) current
I_b, I_c, I_e	Varying component of the current
i_B, i_C, i_E	Instantaneous total value of the current
i_b, i_c, i_e	Instantaneous value of the varying component of the current
I_{BAV}, I_{CAV}, I_{EAV}	Total average current (to distinguish between average and d.c. if necessary)
I_{BEX}, I_{CEX}	Total base, respectively collector current under specified conditions. These symbols are commonly used in case of a reverse biased emitter junction
I_{BM}, I_{CM}, I_{EM}	Maximum (peak) value of the total current
I_{bm}, I_{cm}, I_{em}	Maximum (peak) value of the varying component of the current
I_{CBO}	Collector cut-off current (open emitter)
I_{CEO}	Collector cut-off current (open base)
I_{CBS} or I_{CES}	Collector cut-off current (emitter short-circuited to base)
I_{EBO}	Emitter cut-off current (open collector)
I_F	Total forward current of a diode (d.c. or average)
i_F	Instantaneous total value of the forward current of a diode

Letter symbol	*Definition*
I_{FAV}	Total average forward current of a diode (to distinguish between average and d.c. if necessary)
I_{FM}	Peak forward current of a diode
I_i, I_o	Input, respectively output current of a specified circuit
I_R	Total reverse (cut-off) current of a diode
i_R	Instantaneous total value of the reverse current of a diode
I_{RRM}	Repetitive peak reverse current of a diode
I_{RSM}	Non repetitive peak reverse current of a diode
I_Z	Zener current (d.c. or average)
I_{ZM}	Peak zener current
I_{ZS}	Non repetitive zener current
P_i, P_o	Input, respectively output power of a specified circuit
P_{tot}	Total power dissipation in the device
P_Z	Zener power dissipation
P_{ZM}	Peak zener power dissipation
P_{ZSM}	Non repetitive peak zener power dissipation
Q_s	Recovered charge
r_D	Diode (internal) series resistance
R_S	Source resistance
R_{th}	Thermal resistance
$R_{th\ j\text{-}a}$	Thermal resistance from junction to ambient
$R_{th\ j\text{-}mb}$	Thermal resistance from junction to mounting base
$R_{th\ j\text{-}c}$	Thermal resistance from junction to case
$R_{th\ mb\text{-}h}$	Thermal resistance from mounting base to heat-sink
r_z	Dynamic-slope resistance of a zener diode
S_z	Temperature coefficient of the operating voltage of a zener diode

Letter symbol	*Definition*
T_{amb}	Ambient temperature
T_{case}	Case temperature
t_d	Delay time
t_f	Fall time
t_{fr}	Forward recovery time of a diode
T_j	Junction temperature
t_{off}	Turn off time ($t_{off}=t_s+t_f$)
t_{on}	Turn on time ($t_{on}=t_d+t_r$)
t_r	Rise time
t_{rr}	Reverse recovery time of a diode
t_s	Storage time
T_{stg}	Storage temperature
V_{BB}, V_{CC}, V_{EE}	Supply voltage
V_{BE}, V_{CB}, V_{CE}, V_{EB}	Total value of the voltage (d.c. or average)
V_{be}, V_{cb}, V_{ce}, V_{eb}	Varying component of the voltage
v_{BE}, v_{CB}, v_{CE}, v_{EB}	Instantaneous value of the total voltage
v_{be}, v_{cb}, v_{ce}, v_{eb}	Instantaneous value of the varying component of the voltage
V_{BEfl}	Base-emitter floating voltage (open base)
V_{BEsat}, V_{CEsat}	Saturation voltage at specified bottoming conditions
$V_{(BR)}$	Breakdown voltage
$V_{(BR)CBO}$, $V_{(BR)CEO}$, $V_{(BR)EBO}$	Breakdown voltage between the terminal indicated by the first subscript and the reference terminal (second subscript) when the third terminal is open circuited
$V_{(BR)CER}$	Collector-emitter breakdown voltage with a specified resistance between emitter and base
$V_{(BR)CES}$	Collector-emitter breakdown voltage with the emitter short circuited to the base
V_{CBO}, V_{CEO}, V_{EBO}	Voltage of the terminal indicated by the first subscript w.r.t. the reference terminal (second subscript) with the third terminal open circuited
V_{CEK}	Knee voltage at specified conditions

Letter symbol	*Definition*	
V_{CER}	Collector-emitter voltage with a specified resistance between emitter and base	
V_{CES}	Collector-emitter voltage with the emitter short circuited to the base	
$V_{CE\,.\,sust}$	Collector-emitter sustaining voltage under the condition, indicated by the third subscript	
V_{CEX}	Collector-emitter voltage in a specified circuit. This symbol is commonly used to indicate a reverse biased emitter junction	
V_{EBfl}	Emitter-base floating voltage (open emitter)	
V_F	Continuous forward voltage of a diode	
V_{FM}	Peak forward voltage of a diode	
V_i, V_o	Input, respectively output voltage of a specified circuit	
	Gate-source cut-off voltage	
V_{pt}	Punch through voltage	
V_R	Continuous reverse voltage of a diode	
V_{RM}	Peak reverse voltage of a diode	
V_{RSM}	Non repetitive peak reverse voltage of a diode	
V_Z	Operating voltage (zener voltage) of a zener diode	
y_{ib}, y_{ie}, y_{is}	Input admittance	Output short circuited to a.c.
g_{ib}, g_{ie}, g_{is}	Input conductance	
C_{ib}, C_{ie}, C_{is}	Input capacitance	
b_{ib}, b_{ie}, b_{is}	Input susceptance	
φ_{ib}, φ_{ie}, φ_{is}	Phase angle of input admittance	
y_{fb}, y_{fe}, y_{fs}	Transfer admittance	Output short circuited to a.c.
g_{fb}, g_{fe}, g_{fs}	Transfer conductance	
C_{fb}, C_{fe}, C_{fs}	Transfer capacitance	
b_{fb}, b_{fe}, b_{fs}	Transfer susceptance	
φ_{fb}, φ_{fe}, φ_{fs}	Phase angle of transfer admittance	

Letter symbol	*Definition*	
y_{ob}, y_{oe}, y_{os}	Output admittance	Input short circuited to a.c.
g_{ob}, g_{oe}, g_{os}	Output conductance	
C_{ob}, C_{oe}, C_{os}	Output capacitance	
b_{ob}, b_{oe}, b_{os}	Output susceptance	
φ_{ob}, φ_{oe}, φ_{os}	Phase angle of output admittance	
y_{rb}, y_{re}, y_{rs}	Feedback admittance	Input short circuited to a.c.
g_{rb}, g_{re}, g_{rs}	Feedback conductance	
C_{rb}, C_{re}, C_{rs}	Feedback capacitance	
b_{rb}, b_{re}, b_{rs}	Feedback susceptance	
φ_{rb}, φ_{re}, φ_{rs}	Phase angle of feedback admittance	
Z_{th}	Transient thermal impedance	

LETTER SYMBOLS FOR RECTIFIER DIODES AND THYRISTORS

This system is based on the Recommendations of the INTERNATIONAL ELECTROTECHNICAL COMMISSION.

QUANTITY SYMBOLS

1. Instantaneous values of current, voltage and power, which vary with time are represented by the appropriate lower case letter.

Examples: i, v, p

2. Maximum (peak), average, d.c. and root-mean-square values are represented by the appropriate upper case letter.

Examples: I, V, P

SUBSCRIPTS FOR QUANTITY SYMBOLS

1. Total values are indicated by upper case subscripts.
2. Values of varying components are indicated by lower case subscripts.
3. For power rectifier diodes and thyristors the terminal(s) are *not* indicated in the subscripts, except for the gate-terminal of thyristors.
4. List of subscripts:

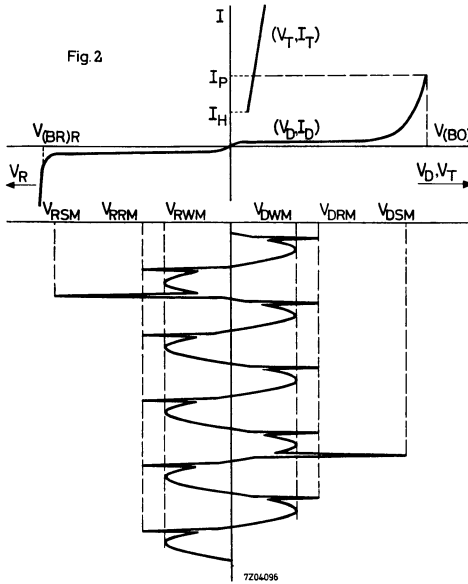
G, g	= Gate terminal
F, f	= Forward[1])
D, d	= Forward off-state[1]); non trigger (gate voltage or current)
T, t	= Forward on-state[1]); trigger (gate voltage or current)
R, r	= As first subscript; Reverse As second subscript: Repetitive

[1]) For the anode-cathode voltage of thyristors F is replaced either by D or by T, to distinguish between "off-state" (non triggered) and "on-state" (triggered).

AV, av = Average value
M, m = Maximum (peak or crest) value
(RMS), (rms) = R.M.S. value
(BR) = Breakdown
(BO) = Breakover
H = Holding
P = Pick-up
Q = Turn off
S = As a second subscript: Non repetitive
W = Working

5. Examples of the application of the rules.
The figure represents a simplified thyristor characteristic together with an anode-cathode voltage as a function of time (no gate signal).

Fig. 2



LIST OF LETTER SYMBOLS FOR RECTIFIER DIODES (R) AND THYRISTORS (T)

Instantaneous values (i, p, v) and a.c. components (lower case subscripts) have been omitted:

Letter symbol	*R*	*T*	*Description*
I_D	—	T	Off-state current (d.c.)
I_F	R	—	Forward current (d.c. or average)
I_{FAV}	R	—	Total average forward current (to distinguish between average and d.c. if necessary)
I_{FGM}	—	T	Forward peak gate current
I_{FRM}	R	—	Repetitive peak forward current
I_{FSM}	R	—	Non repetitive peak forward current
I_H	—	T	Holding current
I_{GT}	—	T	Gate current to trigger the device
I_P	—	T	Pick up current
I_R	R	T	Reverse current (d.c.)
I_{RG}	—	T	Reverse gate current
I_{RRM}	R	T	Repetitive peak reverse current
I_T	—	T	Forward on-state current (d.c.)
I_{TAV}	—	T	Average (forward) on-state current
$I_{T(RMS)}$	—	T	R.M.S. value of the (forward) on-state current
I_{TRM}	—	T	Repetitive peak (forward) on-state current
I_{TSM}	—	T	Non repetitive peak (forward) on-state current
P_{GAV}	—	T	Average gate power dissipation
P_{GM}	—	T	Peak gate power dissipation
P_{RAV}	R	T	Average reverse power dissipation
P_{RRM}	R	T	Repetitive peak reverse power dissipation
P_{RSM}	R	T	Non repetitive peak reverse power dissipation
t_{off}	R	T	Turn-off time ($t_{off} = t_g + t_f$)
t_{on}	R	T	Turn-on time ($t_{on} = t_d + t_r$)

Letter symbol	*R*	*T*	*Description*
$V_{(BO)}$	—	T	Breakover voltage
$V_{(BR)R}$	R	T	Reverse breakdown voltage
V_D	—	T	Continuous off-state voltage
V_{DRM}	—	T	Repetitive peak off-state voltage
V_{DSM}	—	T	Non repetitive peak off-state voltage
V_{DWM}	—	T	Crest working off-state voltage
V_F	R	—	Continuous forward voltage
V_{FGM}	—	T	Forward peak voltage, gate-cathode
V_{GD}	—	T	Gate-cathode voltage not to trigger the device
V_{GT}	—	T	Gate-cathode voltage to trigger the device
V_R	R	T	Continuous reverse voltage
V_{RGM}	—	T	Reverse peak voltage, gate-cathode
V_{RRM}	R	T	Repetitive peak reverse voltage
V_{RSM}	R	T	Non repetitive peak reverse voltage
V_{RWM}	R	T	Crest working reverse voltage
V_T	—	T	Continuous (forward) on-state voltage

LIST OF LETTER SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS

Letter symbol	*Definition*
f	Maximum operating frequency
f_c	Clock rate
I_P	Supply current
M	D.C. noise margin
M_H	D.C. noise margin, signal level HIGH (defined as: $M_H = V_{QH\,min} - V_{GH\,min}$)
M_L	D.C. noise margin, signal level LOW (defined as: $M_L = V_{GLmax} - V_{QLmax}$)
N_a	Available d.c. fan-out (defined as: $N_a = I_{QLmax}/-I_{GLmax}$)
P_{av}	Average power consumption at 50% duty cycle (defined as: $P_{av} = \frac{1}{2} V_P(I_{PH} + I_{PL})$)
P_H	Power consumption, signal level HIGH
P_L	Power consumption, signal level LOW
P_{tot}	Power dissipation, i.e. the total power dissipated by the device
T_{amb}	Operating ambient temperature
t_{pd}	Average propagation delay time (defined as: $t_{pd} = \frac{1}{2}(t_{pdr} + t_{pdf})$)
t_{pdf}	Fall propagation delay time
t_{pdr}	Rise propagation delay time
V_P	Supply voltage

LIST OF LETTER SYMBOLS FOR LINEAR INTEGRATED CIRCUITS

Letter symbol	*Definition*
CMMR	Common-mode rejection ratio
F	Noise figure
f_{c-o}	Cut-off frequency
G_{tr}	Transducer gain
G_v	Voltage gain
I_{io}	Input offset current
I_{OM}	Peak output current
P_o	Output power of a specified circuit
P_{tot}	Total power dissipation in the device
R_L	Load resistance
T_{amb}	Ambient temperature
V_B	Voltage of supply battery
V_i	Input voltage of a specified circuit
V_{io}	Input offset voltage
V_o	Output voltage of a specified circuit
V_{OM}	Peak output voltage swing at $R_L = 10\ \text{k}\Omega$
V_N	Negative supply voltage
V_P	Positive supply voltage
Z_i	Input impedance

REPLACEMENT GUIDE FOR SEMICONDUCTORS AND INTEGRATED CIRCUITS

INTRODUCTION

Semiconductors and integrated circuits listed alphabetically and numerically in the left-hand column of this guide can be replaced by our own types listed opposite them in the right-hand column. If the type numbers in both columns are the same, the recommended replacement completely satisfies the specification of the semiconductor or integrated circuit listed in the left-hand column and is its equivalent.

If the type numbers in both columns differ, the specifications or characteristic data of the recommended replacement may differ in some respect from those of the type listed on the left. Compare their respective data sheets or consult the abridged data in this book.

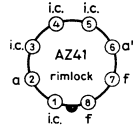
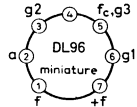
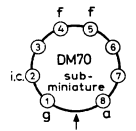
Type numbers given in parentheses are near equivalents of their counterparts in the left-hand column, one or more of the electrical or mechanical data of the two types differing by at least 20 per cent.

Replacement guides for transistors, for small signal diodes, for voltage regulator (zener) diodes, and for integrated circuits are given.
Field effect transistors, thyristors, and rectifier diodes are not listed.

The fact that a semiconductor or integrated circuit is listed does not imply that it can always be supplied.

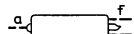
ELECTRON TUBES

RECEIVING AND AMPLIFYING TUBES

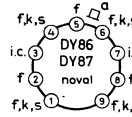
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating and Limiting				
AZ41 Double anode rectifier	4 0.72	$V_{tr} = 2 \times 300$ V_{rms} $V_{tr} = 2 \times 500$ V_{rms}	$I_o = \leqslant 70$ mA $I_o = \leqslant 60$ mA	$R_t = \geqslant 2 \times 100\ \Omega$ $R_t = \geqslant 2 \times 200\ \Omega$	$C_{filt} = 50\ \mu F$	
		Operating class A				
DL96 Output pentode	1.4 0.05 Pins: 5-(1+7)	$V_a = 85$ V $V_{g2} = 85$ V $V_{g1} = -5.2$ V $V_i = 3.5$ V_{rms}	$I_a = 5$ mA $I_{g2} = 0.9$ mA $S = 1.4$ mA/V $R_i = 150$ kΩ	$\mu_{g2g1} = 7$ $R_a = 13$ kΩ $W_o = 0.2$ W $d_{tot} = 10\%$	$W_a = 0.6$ W $W_{g2} = 0.2$ W $I_k = 6$ mA	
		Operating				
DM70 Tuning indicator	1.4 0.025 (Pin 5 pos.)	$V_a = 85$ V $V_g = 0$ V	$I_a = 0.17$ mA	$V_g = -10$ V (for complete extinction)	$W_a = 75$ mW $I_k = 0.6$ mA $V_a =$ min. 45 V	

DM71 = DM70 with short leads

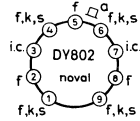
		Typical and Limiting				
DY51 E.H.T. Single anode rectifier	1.4 0.55	$V_a = 100$ V $I_a = 13$ mA $C_a = 0.8$ pF	$-V_{ap} = \leqslant 15$ kV $I_a = \leqslant 0.35$ mA	$I_{ap} = \leqslant 40$ mA [1]) $C_{filt} = \leqslant 2000$ pF	$V_f = < 1.6$ V $V_f = > 1.3$ V	



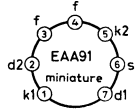
		Operating and Limiting				
DY86-DY87 E.H.T. Single anode rectifier	1.4 0.55	$V_o = 18$ kV $I_o = 0.15$ mA	R_i (at $I_a = 1$ mA) 20 kΩ	$V_{a\,inv.\,p} = \leqslant 22$ kV [3]) $I_o = < 0.5$ mA [2])	$I_{ap} = < 40$ mA [1]) $C_{filt} = < 2000$ pF	



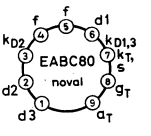
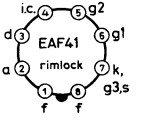
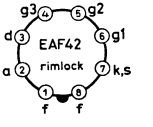
		Operating and Limiting				
DY802 E.H.T. Single anode rectifier	1.4 0.6	$V_o = 20$ kV $I_o = 0.2$ mA	$V_{a\,inv.\,p} = \leqslant 25$ kV [3])	$I_o = \leqslant 0.5$ mA [2])	$I_{ap} = < 50$ mA $C_{filt} = < 3000$ pF	



		Operating and Limiting				
EAA91 Double diode	6.3 0.3	$V_{tr} = 150$ V_{rms} $I_o = 9$ mA	$R_i = \geqslant 300\ \Omega$ $C_{filt} = \leqslant 8\ \mu$F	$V_{+k/-f} = 330$ V $V_{-k/+f} = 150$ V	$-V_{dp} = 420$ V $I_{dp} = 54$ mA	



[1]) Max. duration is 10% of a line scanning cycle, but max. 10 μs. [2]) During short periods as in T.V. operation $I_o = < 0.8$ mA. [3]) Max. duration 22% of a line scanning cycle and max. 18 μs.

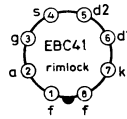
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating (triode)				
EABC80 Triple diode triode	6.3 0.48	V_b = 170 V R_a = 0.1 MΩ $R_{g'}$ = 0.33 MΩ I_a = 0.82 mA V_o/V_i = 42	V_b = 200 V R_a = 0.1 MΩ $R_{g'}$ = 0.33 MΩ I_a = 1 mA V_o/V_i = 44	V_b = 250 V R_a = 0.1 MΩ $R_{g'}$ = 0.33 MΩ I_a = 1.4 mA V_o/V_i = 47	W_a = 1 W I_k = 5 mA V_{kf} = 150 V	
		Typical (diodes)				
		R_{iD1} (at V_{d1} = +10 V) = 5 kΩ	R_{iD2} (at V_{d2} = +5 V) = 200 Ω	R_{iD3} (at V_{d3} = +5 V) = 200 Ω	$V_{d\,inv.\,p}$ = 350 V I_{d1} = 1 mA I_{d2}, I_{d3} = 10 mA	
		Typical (pentode)				
EAF41 Diode- Remote cut-off pentode	6.3 0.2	$V_a = V_b$ = 250 V V_{g1} = −2 V R_{g2} = 95 kΩ	I_a = 5 mA I_{g2} = 1.6 mA S = 1.8 mA/V	R_i = 1.2 MΩ μ_{g2g1} = 19 $R_{eq.}$ = 9 kΩ	W_a = 2 W I_k = 10 mA V_{kf} = 50 V	
		Typical (pentode)				
EAF42 Diode- Remote cut-off pentode	6.3 0.2	$V_a = V_b$ = 250 V V_{g1} = −2 V V_{g3} = 0 V R_{g2} = 110 kΩ	I_a = 5 mA I_{g2} = 1.5 mA S = 2 mA/V	R_i = 1.4 MΩ μ_{g2g1} = 16 $R_{eq.}$ = 7.5 kΩ	W_a = 2 W I_k = 10 mA V_{kf} = 100 V	

EBC41
Double diode triode

6.3
0.23

Typical (triode)

$V_a = 250$ V
$V_g = -3$ V
$I_a = 1$ mA
$S = 1.2$ mA/V
$R_i = 58$ kΩ
$\mu = 70$
$R_{eq.} = < 150$ kΩ
$W_a = 0.5$ W
$I_k = 5$ mA
$V_{kf} = 100$ V



EBC81
Double diode triode

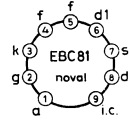
6.3
0.23

Typical (triode)

$V_a = 250$ V
$V_g = -3$ V
$I_a = 1$ mA
$S = 1.2$ mA/V
$R_i = 58$ kΩ
$\mu = 70$
$R_{eq.} = \leqslant 150$ kΩ
$W_a = 0.5$ W
$I_k = 5$ mA
$V_{kf} = 100$ V

Operating (triode)

$V_b = 250$ V
$R_a = 22$ kΩ
$R_k = 1.8$ kΩ
$R_g = 1$ MΩ
$R_{g'} = 0.68$ MΩ
$I_a = 0.7$ mA
$V_o/V_i = 51$



EBF80
Double diode
Remote cut-off pentode

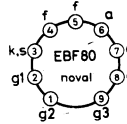
6.3
0.3

Typical (pentode)

$V_a = V_b = 250$ V
$V_{g1} = -2$ V
$V_{g3} = 0$ V
$R_{g2} = 95$ kΩ
$I_a = 5$ mA
$I_{g2} = 1.75$ mA
$S = 2.2$ mA/V
$R_i = 1.4$ MΩ
$\mu_{g2g1} = 18$
$R_{eq.} = 6.8$ kΩ
$W_a = 1.5$ W
$I_k = 10$ mA
$V_{kf} = 100$ V

Operating (pentode)

$V_b = 250$ V
$R_a = 0.22$ MΩ
$R_{g2} = 0.82$ MΩ
$R_{g1} = 1$ MΩ
$R_{g1'} = 0.68$ MΩ
$R_k = 1.8$ kΩ
$I_a = 0.75$ mA
$I_{g2} = 0.3$ mA
$V_o/V_i = 110$

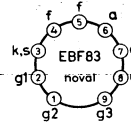


EBF83
Double diode
Remote cut-off pentode

6.3
0.3

Typical (pentode)

$V_a = 12.6$ V
$V_{g2} = 12.6$ V
$V_{g3} = 0$ V
$V_{g1} = {}^1)$ V
$I_a = 0.45$ mA
$I_{g2} = 0.14$ mA
$S = 1$ mA/V
$R_i = 1$ MΩ
$C_{ag1} = < 2.5$ mpF
$I_k = 5$ mA
$V_{kf} = 50$ V



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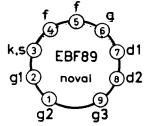
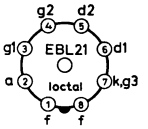
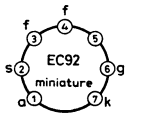
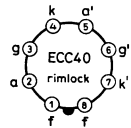
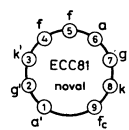
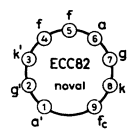
[1]) Obtained by grid current biasing, $R_{g1} = 2.2$ MΩ.

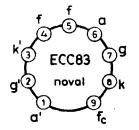
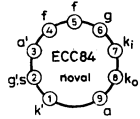
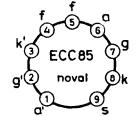
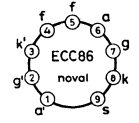
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical (pentode)				
EBF89 Double diode Remote cut-off pentode	6.3 0.3	V_a = 250 V V_{g2} = 100 V V_{g3} = 0 V	V_{g1} = −2 V I_a = 9 mA I_{g2} = 2.7 mA	S = 3.8 mA/V R_i = 1 MΩ μ_{g2g1} = 20	W_a = 2.25 W I_k = 16.5 mA V_{kf} = 100 V	
		Operating class A (pentode)				
EBL21 Double diode Output pentode	6.3 0.8	V_a = 250 V V_{g2} = 250 V V_{g1} = −6 V V_i = 4.2 V_{rms}	I_a = 36 mA I_{g2} = 4.5 mA S = 9 mA/V R_i = 50 kΩ	μ_{g2g1} = 23 R_a = 7 kΩ W_a = 4.5 W d_{tot} = 10%	W_a = 11 W I_k = 60 mA V_{kf} = 50 V	
EC86	6.3 0.2	For further data see PC86			$V_{+k/-f}$ = 100 V $V_{-k/+f}$ = 50 V	
EC88	6.3 0.165	For further data see PC88				
		Typical				
EC92 R.F. triode	6.3 0.15	V_a = 250 V V_g = −2 V V_a = 100 V V_g = −1 V	I_a = 10 mA S = 5.5 mA/V I_a = 3 mA S = 3.8 mA/V	R_i = 11 kΩ μ = 60 R_i = 16.5 kΩ μ = 62	W_a = 2.5 W I_k = 15 mA V_{kf} = 100 V	

EC97	6.3 0.215	For further data see PC97			
EC900	6.3 0.18	For further data see PC900			
		Operating			
ECC40	6.3	$V_b = 250$ V	$R_{g'} = 0.33$ MΩ	$V_o = < 44$ V_{rms}	$W_a = 1.5$ W
A.F. double-	0.6	$R_a = 0.1$ MΩ	$R_k = 2.2$ kΩ	$V_o/V_i = 24$	$I_k = 10$ mA
triode		$R_g = 1$ MΩ	$I_a = 1.4$ mA	$d_{tot} = 3.7\,\%$	$V_{kf} = 100$ V
		Typical			
ECC81	6.3	$V_a = 250$ V	$I_a = 10$ mA	$R_i = 11$ kΩ	$W_a = 2.5$ W
R.F. double-	0.3	$V_g = -2$ V	$S = 5.5$ mA/V	$\mu = 60$	$I_k = 15$ mA
triode	or				$V_{kf} = 90$ V
	12.6	$V_a = 100$ V	$I_a = 3$ mA	$R_i = 16.5$ kΩ	
	0.15	$V_g = -1$ V	$S = 3.8$ mA/V	$\mu = 6.2$	
		Typical			
ECC82	6.3	$V_a = 250$ V	$I_a = 10.5$ mA	$R_i = 7.7$ kΩ	$W_a = 2.75$ W
A.F. double	0.3	$V_g = -8.5$ V	$S = 2.2$ mA/V	$\mu = 17$	$I_k = 20$ mA
triode	or				$V_{kf} = 180$ V
		Operating			
	12.6	$V_b = 250$ V	$R_{g'} = 0.33$ MΩ	$V_o = 32$ V_{rms}	
	0.15	$R_a = 0.1$ MΩ	$R_k = 2.2$ kΩ	$V_o/V_i = 14$	
		$R_g = 1$ MΩ	$I_a = 1.63$ mA	$d_{tot} = 5.9\,\%$	



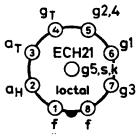




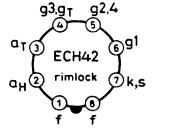
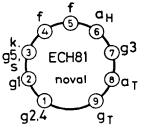
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical				
ECC83 A.F. double-triode	6.3 0.3 or	$V_a = 250$ V $V_g = -2$ V	$I_a = 1.2$ mA $S = 1.6$ mA/V	$R_i = 62.5$ kΩ $\mu = 100$	$W_a = 1$ W $I_k = 8$ mA $V_{kf} = 180$ V	
		Operating				
	12.6 0.15	$V_b = 250$ V $R_a = 0.1$ MΩ $R_g = 1$ MΩ	$R_{g'} = 0.33$ MΩ $R_k = 1.5$ kΩ $I_a = 0.86$ mA	$V_o = 26$ V_{rms} $V_o/V_i = 54.5$ $d_{tot} = 3.9\%$		
		Typical				
ECC84 Double-triode	6.3 0.33	$V_a = 90$ V $V_g = -1.5$ V	$I_a = 12$ mA $S = 6$ mA/V	$R_i = 4$ kΩ $\mu = 24$	$W_a = 2$ W $I_k = 22$ mA $V_{kf} = 100$ V	
		Typical				
ECC85 R.F. double-triode	6.3 0.435	$V_a = 250$ V $V_g = -2.7$ V	$I_a = 10$ mA $S = 6.1$ mA/V	$R_i = 9$ kΩ $\mu = 55$	$W_a = 2.5$ W $I_k = 15$ mA $V_{kf} = 90$ V	
		Typical				
ECC86 Double-triode	6.3 0.33	$V_a = 6.3$ V $V_g = -0.4$ V	$I_a = 0.9$ mA $S = 2.6$ mA/V	$R_i = 5.4$ kΩ $\mu = 14$	$W_a = 0.6$ W $I_k = 20$ mA $V_{kf} = 30$ V	
ECC88	6.3 0.365	For further data see PCC88				
ECC189	6.3 0.365	For further data see PCC189			$V_{kf} = 50$ V	

ECF80	6.3 0.43	For further data see PCF80	$V_{kf} = 100$ V
ECF86	6.3 0.39	For further data see PCF86	$V_{kf} = 100$ V
ECF200	6.3 0.41	For further data see PCF200	
ECF201	6.3 0.41	For further data see PCF201	
ECF801	6.3 0.41	For further data see PCF801	
ECF802	6.3 0.43	For further data see PCF802	$V_{kf} = 100$ V

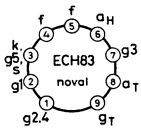
ECH21 Triode- heptode	6.3 0.33	*Frequency changer (heptode)* $V_a = V_b = 250$ V $R_{g2+g4} = 24$ kΩ $R_{gT+g3} = 50$ kΩ $V_{g1} = -2$ V	$I_a = 3$ mA $I_{g2+g4} = 6.2$ mA $I_{gT+g3} = 0.19$ mA	$S_c = 0.75$ mA/V $R_i = 1.4$ MΩ $R_{eq.} = 55$ kΩ	$W_a = 1.5$ W $I_k = 15$ mA $V_{kf} = 50$ V
		Oscillator (triode) $V_b = 250$ V $R_a = 20$ kΩ	$R_{gT+g3} = 50$ kΩ $I_{gT+g3} = 0.19$ mA	$I_a = 4.5$ mA $S_{eff} = 0.55$ mA/V	$W_a = 0.8$ W

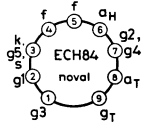


RECEIVING AND AMPLIFYING TUBES

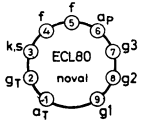
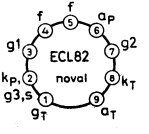
Type and application	V_f (V) I_f (A)	*Characteristic data*				*Limiting values*	*Base connections*
		Frequency changer (hexode)					
ECH42 Triode-hexode	6.3 0.23	$V_a = V_b = 250$ V $R_1 = 27$ kΩ $R_2 = 27$ kΩ $R_{gT+g3} = 22$ kΩ	$V_{g1} = -2$ V $I_a = 3$ mA $I_{g2+g4} = 3$ mA $I_{gT+g3} = 0.35$ mA	$S_c = 0.75$ mA/V $R_i = \geqslant 1$ MΩ $R_{eq.} = 0.1$ MΩ		$W_a = 1.5$ W $I_k = 10$ mA $V_{kf} = 100$ V	
		Oscillator (triode)					
		$V_b = 250$ V $R_a = 33$ kΩ $R_{gT+g3} = 22$ kΩ	$I_{gT+g3} = 0.35$ mA $I_a = 5.1$ mA	$V_{osc} = 8$ V_{rms} $S_{eff} = 0.6$ mA/V		$W_a = 0.8$ W $I_k = 6$ mA	
		Frequency changer (heptode)					
ECH81 Triode-heptode	6.3 0.3	$V_b = 250$ V $R_a = 8.2$ kΩ $R_{g2+g4} = 22$ kΩ $R_{gT+g3} = 47$ kΩ	$I_a = 3.3$ mA $I_{g2+g4} = 7.8$ mA $I_{gT+g3} = 0.2$ mA $I_{g1} = 0.5$ μA [1]	$S_c = 1.1$ mA/V $R_i = 0.8$ MΩ $R_{eq.} = 30$ kΩ		$W_a = 2$ W $I_k = 18$ mA $V_{kf} = 100$ V	
		Operating (heptode)					
		$V_b = 250$ V $R_a = 8.2$ kΩ $R_{g2+g4} = 22$ kΩ $V_{g3} = 0$ V	$I_a = 11$ mA $I_{g2+g4} = 7$ mA $I_{g1} = 0.5$ μA [1] $S = 4.5$ mA/V	$R_i = 0.24$ MΩ $\mu_{g2g1} = 25$ $R_{eq.} = 4.5$ kΩ			
		Oscillator (triode)					
		$V_b = 250$ V $R_a = 33$ kΩ	$R_{gT+g3} = 47$ kΩ $I_{gT+g3} = 0.2$ mA	$I_a = 4.5$ mA $S_{eff} = 0.65$ mA/V		$W_a = 0.8$ W $I_k = 6.5$ mA	

		Frequency changer (heptode)			
ECH83	6.3	V_a = 12.6 V	R_{g3} = 47 kΩ	I_{g3} = 18 μA	I_k = 5 mA
Triode-	0.3	V_{g2+g4} = 12.6	I_a = 0.17 mA	S_c = 0.22 mA/V	V_{kf} = 150 V
heptode		V_{g1} = [2]) V	I_{g2+g4} = 0.3 mA	R_i = 1.5 MΩ	
		V_{osc} = 1.7 V_{rms}			
		Operating (heptode)			
		V_a = 12.6 V	I_a = 0.4 mA	R_i = 0.85 MΩ	
		$V_{g2+g3+g4}$ = 12.6 V	$I_{g2+g3+g4}$ = 0.25 mA	$R_{eq.}$ = 6.5 kΩ	
		V_{g1} = [2]) V	S = 0.75 mA/V		
		Typical (triode)			
		V_a = 12.6 V	I_a = 0.75 mA	R_i = 13 kΩ	W_a = 0.8 W
		V_{g1} = [3]) V	S = 1.4 mA/V	μ = 18.3	I_k = 6.5 mA
		Typical (heptode)			
ECH84	6.3	V_a = 135 V	V_{g1} = 0 V	I_{g2+g4} = 0.9 mA	W_a = 1.7 W
Triode-	0.3	V_{g3} = 0 V	I_a = 1.7 mA	S = 2.2 mA/V	I_k = 12.5 mA
heptode		V_{g2+g4} = 14 V			V_{kf} = 100 V
		Typical (triode)			
		V_a = 50 V	I_a = 3 mA	R_i = 13.5 kΩ	W_a = 1.3 W
		V_g = 0 V	S = 3.7 mA/V	μ = 50	I_k = 10 mA
ECH200	6.3	For further data see PCH200			V_{kf} = 100 V
	0.435				





[1]) Grid current bias obtained with R_{g1} = 1 MΩ and with zero Volts a.g.c. voltage; resulting grid one voltage: −0.5 V
[2]) Obtained by grid current biasing; R_{g1} = 1 MΩ. [3]) Obtained by grid current biasing: R_{g1} = 47 kΩ.

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating class A (pentode)				
ECL80 Triode- output pentode	6.3 0.3	V_a = 200 V V_{g2} = 200 V V_{g3} = 0 V V_{g1} = −8 V	I_a = 17.5 mA I_{g2} = 3.3 mA S ≈ 3.3 mA/V R_i = 0.15 MΩ	μ_{g2g1} = 14 $R_{a\sim}$ = 11 kΩ W_o = 1.75 W V_i = 5.1 V_{rms}	W_a = 3.5 W I_k = 25 mA V_{kf} = 150 V	
		Operating (triode)				
		V_b = 200 V R_a = 0.1 MΩ R_g = 0.33 MΩ	I_a = 1.2 mA V_o = 29 V_{rms}	V_o/V_i = 10 d_{tot} = 8 %	W_a = 1 W I_k = 8 mA	
		Operating class A (pentode)				
ECL82 Triode- output pentode	6.3 0.78	$V_{ba} = V_{bg2}$ = 272 V R_{g2} = 2.2 kΩ R_k = 650 Ω $R_{a\sim}$ = 8 kΩ	I_a = 28 mA I_{g2} = 6.5 mA at V_i = 0 V I_a = 27 mA	I_{g2} = 10.8 mA at V_i = 9.5 V_{rms} W_o = 3.5 W d_{tot} = 10 %	W_a = 5 W I_k = 50 mA V_{kf} = 150 V	
		Operating (triode)				
		V_b = 200 V R_a = 0.22 MΩ R_g = 3 MΩ $R_{g'}$ = 0.68 MΩ	R_k = 2.2 kΩ R_s = 0.22 MΩ I_a = 0.52 mA	V_o = 26 V_{rms} V_o/V_i = 51 d_{tot} = 1.6 %	W_a = 1 W I_k = 15 mA V_{kf} = 100 V	
ECL84	6.3 0.72	For further data see PCL84			V_{kf} = 200 V	
ECL85 **ECL805**	6.3 0.875	For further data see PCL85			V_{kf} = 100 V	

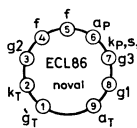
ECL86 6.3
Triode-output pentode 0.66

Operating class A (pentode)

V_a = 250 V	I_a = 36 mA	I_{g2} = 10.2 mA	W_a = 9 W
V_{g2} = 250 V	I_{g2} = 6 mA	at V_i = 3.2 V_{rms}	I_k = 55 mA
R_k = 170 Ω	at V_i = 0 V	W_o = 4 W	V_{kf} = 100 V
$R_{a\sim}$ = 7 kΩ	I_a = 37 mA	d_{tot} = 10%	

Operating (triode)

V_b = 250 V	R_k = 1.75 kΩ	V_o = 3.2 V_{rms}	W_a = 0.5 W
R_g = 0.22 MΩ	I_a = 0.6 mA	V_o/V_i = 70	I_k = 4 mA
$R_{g'}$ = 0.68 MΩ		d_{tot} = 0.4%	V_{kf} = 100 V



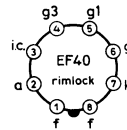
ED500 6.3
0.35

For further data see PD500

Operating

EF40 6.3
A.F. pentode 0.2

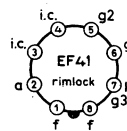
V_b = 250 V	R_{g1} = 1 MΩ	I_k = 2 mA	W_a = 1 W
R_a = 0.1 MΩ	$R_{g1'}$ = 0.33 MΩ	V_o/V_i = 112	I_k = 6 mA
R_{g2} = 0.39 MΩ	R_k = 1 kΩ		V_{kf} = 100 V



Typical

EF41 6.3
Remote cut-off pentode 0.2

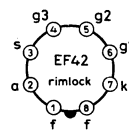
$V_a = V_b$ = 250 V	I_a = 6 mA	R_i = 1.1 MΩ	W_a = 2 W
R_{g2} = 90 kΩ	I_{g2} = 1.7 mA	μ_{g2g1} = 18	I_k = 10 mA
V_{g1} = −2.5 V	S = 2.2 mA/V	$R_{eq.}$ = 6.5 kΩ	V_{kf} = 100 V



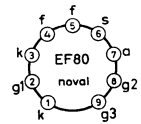
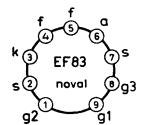
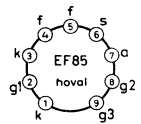
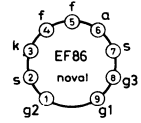
Typical

EF42 6.3
Wide band sharp cut-off pentode 0.33

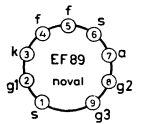
V_a = 250 V	I_a = 10 mA	R_i = 0.5 MΩ	W_a = 3.5 W
V_{g2} = 250 V	I_{g2} = 2.4 mA	μ_{g2g1} = 83	I_k = 25 mA
V_{g3} = 0 V	S = 9 mA/V	$R_{eq.}$ = 840 Ω	V_{kf} = 100 V
V_{g1} = −2 V			

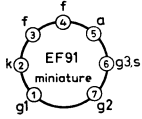


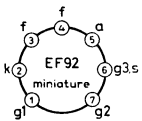
RECEIVING AND AMPLIFYING TUBES

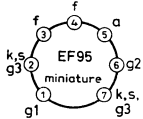
Type and application	V_f (V) I_f (A)	*Characteristic data*				*Limiting values*	*Base connections*
		Typical					
EF80 Sharp cut-off pentode	6.3 0.3	V_a = 170 V V_{g2} = 170 V V_{g3} = 0 V V_{g1} = −2 V	I_a = 10 mA I_{g2} = 2.5 mA S = 7.4 mA/V	R_i = 0.5 MΩ μ_{g2g1} = 50 $R_{eq.}$ = 1 kΩ		W_a = 2.5 W I_k = 15 mA V_{kf} = 150 V	
		Typical					
EF83 Remote cut-off pentode	6.3 0.2	V_a = 250 V V_{g2} = 50 V V_{g3} = 0 V	V_{g1} = −1.6 V I_a = 4 mA I_{g2} = 1.15 mA	S = 1.6 mA/V R_i = 1.6 MΩ μ_{g2g1} = 10		W_a = 1 W I_k = 6 mA V_{kf} = 100 V	
		Typical					
EF85 Remote cut-off wide band pentode	6.3 0.3	$V_a = V_b$ = 250 V R_{g2} = 60 kΩ V_{g3} = 0 V V_{g1} = −2 V	I_a = 10 mA I_{g2} = 2.5 mA S = 6 mA/V	R_i = 0.6 MΩ μ_{g2g1} = 26 $R_{eq.}$ = 1.4 kΩ		W_a = 2.5 W I_k = 15 mA V_{kf} = 150 V	
		Operating					
EF86 A.F. pentode	6.3 0.2	V_b = 250 V R_a = 0.1 MΩ R_{g2} = 0.39 MΩ	R_k = 1 kΩ $R_{g1'}$ = 0.33 MΩ I_k = 2 mA	V_o = 50 V_{rms} V_o/V_i = 123 d_{tot} = 5%		W_a = 1 W I_k = 6 mA V_{kf} = 100 V	

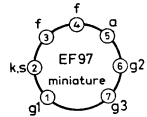
		Typical				
EF89	6.3	$V_a = V_b = 250$ V	$V_{g1} = -2$ V	$S = 3.5$ mA/V	$W_a = 2.25$ W	
Remote cut-off	0.2	$R_{g2} = 50$ kΩ	$I_a = 9$ mA	$R_i = 0.9$ MΩ	$I_k = 16.5$ mA	
pentode		$V_{g3} = 0$ V	$I_{g2} = 3$ mA	$R_{eq.} = 4.2$ kΩ	$V_{kf} = 100$ V	
		Typical				
EF91	6.3	$V_a = 250$ V	$I_a = 10$ mA	$R_i = 1$ MΩ	$W_a = 2.5$ W	
Sharp cut-off	0.3	$V_{g2} = 250$ V	$I_{g2} = 2.55$ mA	$\mu_{g2g1} = 70$	$I_k = 15$ mA	
pentode		$V_{g3} = 0$ V	$S = 7.6$ mA/V	$R_{eq.} = 1.2$ kΩ	$V_{kf} = 150$ V	
		$V_{g1} = -2$ V				
		Typical				
EF92	6.3	$V_a = 250$ V	$V_{g1} = -0.65$ V	$S = 2.5$ mA/V	$W_a = 2.5$ W	
Remote cut-off	0.2	$V_{g2} = 150$ V	$I_a = 8$ mA	$\mu_{g2g1} = 30$	$I_k = 12$ mA	
		$V_{g3} = 0$ V	$I_{g2} = 2$ mA		$V_{kf} = 100$ V	
		Typical				
EF95	6.3	$V_a = 180$ V	$I_a = 7.7$ mA	$R_i = 0.69$ MΩ	$W_a = 1.7$ W	
Sharp cut-off	0.175	$V_{g2} = 120$ V	$I_{g2} = 2.4$ mA	$R_{eq.} = 2$ kΩ	$I_k = 18$ mA	
pentode		$R_k = 200$ Ω	$S = 5.1$ mA/V		$V_{kf} = 90$ V	
		Typical				
EF97	6.3	$V_a = 12.6$ V	$V_{g1} = -0.7$ V	$S = 2.1$ mA/V	$W_a = 0.5$ W	
Remote cut-off	0.3	$V_{g2} = 6.3$ V	$I_a = 3.3$ mA	$R_i = 50$ kΩ	$I_k = 15$ mA	
pentode		$V_{g3} = 0$ V	$I_{g2} = 0.95$ mA	$R_{eq.} = 5$ kΩ	$V_{kf} = 50$ V	



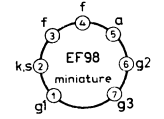
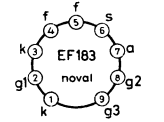
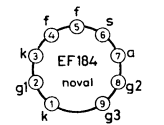
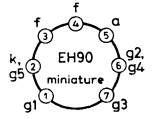




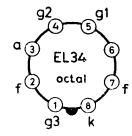




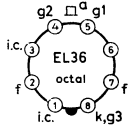
RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	Characteristic data				Limiting values	Base connections
		Typical					
EF98 Sharp cut-off pentode	6.3 0.3	V_a = 12.6 V V_{g2} = 6.3 V V_{g3} = 0 V	V_{g1} = −0.75 V I_a = 2 mA I_{g2} = 0.7 mA	S = 2 mA/V R_i = 0.2 MΩ μ_{g2g1} = 4.1	W_a = 0.5 W I_k = 15 mA V_{kf} = 50 V	
		Typical					
EF183 Remote cut-off pentode	6.3 0.3	V_a = 200 V V_{g2} = 90 V V_{g3} = 0 V	V_{g1} = −2 V I_a = 12 mA I_{g2} = 4.5 mA	S = 12.5 mA/V R_i = 0.5 MΩ $R_{eq.}$ = 490 Ω	W_a = 2.5 W I_k = 20 mA V_{kf} = 150 V	
		Typical					
EF184 Sharp cut-off pentode	6.3 0.3	V_a = 200 V V_{g2} = 200 V V_{g3} = 0 V V_{g1} = −2.5 V	I_a = 10 mA I_{g2} = 4.1 mA S = 15 mA/V	R_i = 380 kΩ μ_{g2g1} = 60 $R_{eq.}$ = 330 Ω	W_a = 2.5 W I_k = 25 mA V_{kf} = 150 V	
EFL200	6.3 0.81	For further data see PFL200					
		Operating					
EH90 Dual controle heptode	6.3 0.3	V_a = 100 V V_{g2+g4} = 30 V V_{g1} = −1 V	V_{g3} = 0 V I_a = 0.75 mA I_{g2+g4} = 1.1 mA	S_{g1} = 1.1 mA/V R_i = 0.9 MΩ	W_a = 1 W I_k = 14 mA $V_{+k/-f}$ = 200 V $V_{-k/+f}$ = 100 V	

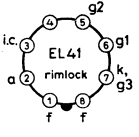
		Operating class A			
EL34	6.3	V_a = 250 V	I_a = 100 mA	$R_{a\sim}$ = 2 kΩ	W_a = 25 W
A.F. output	1.5	V_{g2} = 265 V	I_{g2} = 15 mA	W_o = 11 W	I_k = 150 mA
pentode		V_{g1} = −13.5 V	S = 12.5 mA/V	V_i = 8.7 V_{rms}	V_{kf} = 100 V
		V_{g3} = 0 V	R_i = 17 kΩ	d_{tot} = 10%	
		Class AB			
		V_b = 375 V	I_a = 2 × 75 mA	I_{g2} = 2 × 22 mA	
		$R_{aa\sim}$ = 3.4 kΩ	I_{g2} = 2 × 11 mA	at V_i = 21 V_{rms}	
		R_k = 130 Ω	at V_i = 0 V	W_o = 35 W	
		R_{g2} = 470 Ω	I_a = 2 × 95 mA	d_{tot} = 5%	
		V_{g3} = 0 V			

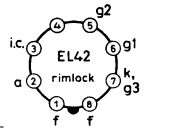
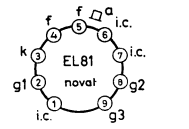
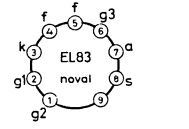


		Typical			
EL36	6.3	V_a = 100 V	I_a = 100 mA	R_i = 5 kΩ	W_a = 12 W
Line and A.F.	1.25	V_{g2} = 100 V	I_{g2} = 7 mA	μ_{g2g1} = 5.6	W_{g2} = 5 W
output pentode		V_{g1} = −8.2 V	S = 14 mA/V		I_k = 200 mA
					V_{kf} = 100 V
		Operating class A			
		V_a = 300 V	I_a = 2 × 18 mA	I_{g2} = 2 × 19 mA	
		V_{g2} = 150 V	I_{g2} = 2 × 0.5 mA	at V_i = 20 V_{rms}	
		V_{g1} = −29 V	at V_i = 0 V	W_o = 44.5 W	
		$R_{aa\sim}$ = 3.5 kΩ	I_a = 2 × 100 mA	d_{tot} = 7.2%	

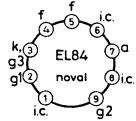


		Operating class A			
EL41	6.3	V_a = 250 V	I_{g2} = 5.2 mA	$R_{a\sim}$ = 7 kΩ	W_a = 9 W
A.F. output	0.71	V_{g2} = 250 V	S = 10 mA/V	W_o = 3.9 W	I_k = 55 mA
pentode		R_k = 170 Ω	R_i = 40 kΩ	V_i = 3.8 V_{rms}	V_{kf} = 100 V
		I_a = 36 mA	μ_{g2g1} = 22	d_{tot} = 10%	

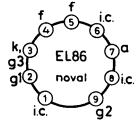


Type and application	V_f (V) I_f (A)	Characteristic data			Limiting values	Base connections
		Operating class A				
EL42 A.F. output pentode	6.3 0.2	V_a = 225 V V_{g2} = 225 V R_k = 360 Ω I_a = 26 mA	I_{g2} = 4.1 mA S = 3.2 mA/V R_i = 90 kΩ μ_{g2g1} = 11	$R_{a\sim}$ = 9 kΩ W_o = 2.8 W V_i = 8 V_{rms} d_{tot} = 12%	W_a = 6 W I_k = 35 mA V_{kf} = 100 V	
		Typical				
EL81 Output pentode for line deflection and A.F. output pentode	6.3 1.05	V_a = 170 V V_{g2} = 170 V V_{g3} = 0 V	V_{g1} = −24 V I_a = 45 mA I_{g2} = 2.4 mA	S = 6,3 mA/V R_i = 11 kΩ μ_{g2g1} = 5,1	W_a = 7.5 W I_k = 180 mA V_{kf} = 100 V	
		Operating class B				
		V_a = 200 V V_{bg2} = 200 V R_{g2} = 1 kΩ $R_{aa\sim}$ = 2.5 kΩ	V_{g1} = −31,5 V I_a = 2 × 27 mA I_{g2} = 2 × 2 at V_i = 0 V	I_a = 2 × 84 mA I_{g2} = 2 × 11 mA at V_i = 21.5 V_{rms} W_o = 20 W d_{tot} = 6.5%		
EL82	6.3 0.8	For further data see PL82			V_{kf} = 100 V	
		Typical				
EL83 Video output pentode	6.3 0.71	V_a = 250 V V_{g2} = 250 V V_{g3} = 0 V	V_{g1} = −5.5 V I_a = 36 mA I_{g2} = 5 mA	S = 10 mA/V R_i = 0.13 MΩ μ_{g2g1} = 24	W_a = 9 W I_k = 70 mA V_{kf} = 100 V	

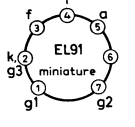
		Operating class A				
EL84	6.3	V_a = 250 V	I_{g2} = 5.5 mA	$R_{a\sim}$ = 5.2 kΩ	W_a = 12 W	
A.F. output	0.76	V_{g2} = 250 V	S = 11.3 mA/V	W_o = 5.7 W	I_k = 65 mA	
pentode		R_k = 135 Ω	R_i = 38 kΩ	V_i = 4.3 V_{rms}	V_{kf} = 100 V	
		I_a = 48 mA	μ_{g2g1} = 19	d_{tot} = 10%		
		Class B				
		V_a = 300 V	I_a = 2 × 7.5 mA	I_{g2} = 2 × 11 mA		
		V_{g2} = 300 V	I_{g2} = 2 × 0.8 mA	at V_i = 10 V_{rms}		
		V_{g1} = −14.7 V	at V_i = 0 V	W_o = 17 W		
		$R_{aa\sim}$ = 8 kΩ	I_a = 2 × 46 mA	d_{tot} = 4%		



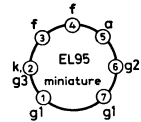
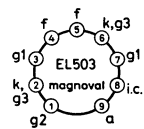
		Operating class A				
EL86	6.3	V_b = 200 V	$R_{a\sim}$ = 2.5 kΩ	V_i = 7 V_{rms}	W_a = 12 W	
Frame and A.F.	0.76	R_{g2} = 470 Ω	I_a = 64 mA	W_o = 5.3 W	I_k = 100 mA	
output pentode		R_k = 215 Ω	I_{g2} = 11.4 mA	d_{tot} = 10%	V_{kf} = 200 V	
		Class AB				
		V_{ba} = 250 V	I_a = 2 × 50 mA	I_{g2} = 2 × 13 mA		
		V_{bg2} = 200 V	I_{g2} = 2 × 2 mA	at V_i = 13 V_{rms}		
		R_k = 150 Ω	at V_i = 0 V	W_o = 18.5 W		
		$R_{aa\sim}$ = 5.5 kΩ	I_a = 2 × 55 mA	d_{tot} = 4.5%		



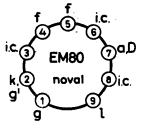
		Operating class A				
EL91	6.3	V_a = 250 V	I_a = 16 mA	W_o = 1.4 W	W_a = 4 W	
A.F. output	0.2	V_{g2} = 250 V	I_{g2} = 2.4 mA	V_i = 5.3 V_{rms}	I_k = 25 mA	
pentode		R_k = 740 Ω	R_a = 16 kΩ	d_{tot} = 10%	$V_{+k/-f}$ = 150 V	

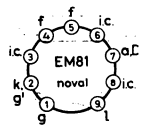


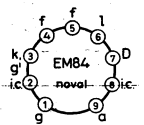
RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
EL95 A.F. output pentode	6.3 0.2	*Typical* V_a = 250 V V_{g2} = 250 V V_{g1} = −9 V	I_a = 24 mA I_{g2} = 4,5 mA S = 5,4 mA/V	μ_{g2g1} = 17 R_i = 70 kΩ	W_a = 6 W I_k = 35 mA V_{kf} = 100 V	
		Operating class A V_a = 250 V V_{g2} = 250 V R_k = 320 Ω	I_a = 24 mA I_{g2} = 4.5 mA $R_{a\sim}$ = 10 kΩ	V_i = 5 V_{rms} W_o = 3 W d_{tot} = 10%		
EL500	6.3 1.38	For further data see PL500			W_a = 12 W V_{kf} = 200 V	
EL503 A.F. output pentode	6.3 1.05	*Typical* V_a = 250 V V_{g2} = 250 V V_{g1} = −14 V	I_a = 110 mA I_{g2} = 7 mA S = 23 mA/V	μ_{g2g1} = 13 R_i = 5.4 kΩ	W_a = 29 W I_k = 200 mA V_{kf} = 100 V	
		Operating class AB V_{ba} = 265 V V_{bg2} = 265 V R_k = 56 Ω $R_{aa\sim}$ = 2.4 kΩ	I_a = 2 × 115 mA I_{g2} = 2 × 7.5 mA at V_i = 0 V I_a = 2 × 125 mA	I_{g2} = 2 × 36 mA at V_i = 12.2 V_{rms} W_o = 40 W d_{tot} = 5%		
EL504	6.3 1.38	For further data see PL504			V_{kf} = 200 V	

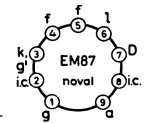
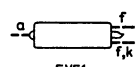
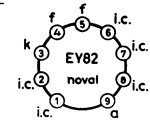
EL508	6.3 0.825	For further data see PL508			$V_{kf}=100$ V
EL509	6.3 2.0	For further data see PL509			$V_{kf}=200$ V
EL519	6.3 2.0	For further data see PL519			$V_{kf}=200$ V
EL802	6.3 0.8	For further data see PL802			$V_{kf}=100$ V
		Operating			
EM80	6.3	$V_b=V_l=250$ V	$V_{bg}=-1$ V	$V_{bg}=-14$ V	$W_a=0.2$ W
Tuning	0.3	$R_a=0.5$ MΩ	$I_a=0.37$ mA	$I_a=0.01$ mA	$I_k=3$ mA
indicator		$R_g=3$ MΩ	$I_l=2$ mA	$I_l=2.3$ mA	$V_{kf}=100$ V
			$\beta=5°$	$\beta=50°$	
		Operating			
EM81	6.3	$V_b=V_l=250$ V	$V_{bg}=-1$ V	$V_{bg}=-10.5$ V	$W_a=0.2$ W
Tuning	0.3	$R_a=0.5$ MΩ	$I_a=0.37$ mA	$I_a=0.02$ mA	$I_k=3$ mA
indicator		$R_g=3$ MΩ	$I_l=2$ mA	$I_l=2.3$ mA	$V_{kf}=100$ V
			$\alpha=65°$	$\alpha=5°$	
		Operating			
EM84	6.3	$V_b=V_l=250$ V	$V_{bg}=0$ V	$V_{bg}=-22$ V	$W_a=0.5$ W
Tuning	0.21	$R_{a,D}=470$ kΩ	$I_{a+D}=0.45$ mA	$I_{a+D}=0.06$ mA	$I_k=3$ mA
indicator		$R_g=3$ MΩ	$I_l=1$ mA	$I_l=1.8$ mA	$V_{kf}=100$ V
			$\alpha=21$ mm	$\alpha=0$ mm	

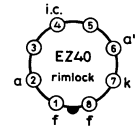
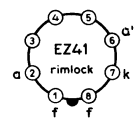
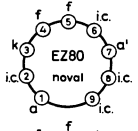
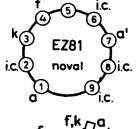
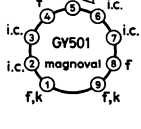




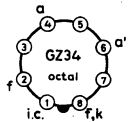
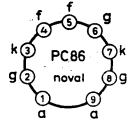
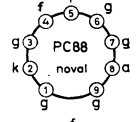
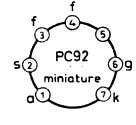


RECEIVING AND AMPLIFYING TUBES

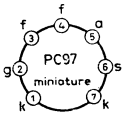
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating				
EM87 Tuning indicator	6.3 0.3	$V_b = V_l = 250$ V $R_{g,D} = 100$ kΩ $R_g = 3$ MΩ	$V_{bg} = 0$ V $I_{a+D} = 2$ mA $I_l = 1$ mA $\alpha = 21$ mm	$V_{bg} = -15$ V $I_{a+D} = 0.2$ mA $I_l = 2$ mA $\alpha = -1.5$ mm	$W_a = 0.6$ W $I_k = 5$ mA $V_{kf} = 250$ V	
		Operating and Limiting				
EY51 E.H.T. rectifier diode	6.3 0.09	$V_{tr} = \leqslant 5$ kV$_{rms}$ $I_o = \leqslant 3$ mA $R_t = \geqslant 0.1$ MΩ $C_{filt} = \leqslant 0.1$ μF $f = 50$ Hz	$V_{ainv.p} = < 17$ kV $I_o = \leqslant 3$ mA $R_t = \geqslant 0.1$ MΩ $C_{filt} = \leqslant 0.01$ μF $f = 10$–500 KHz	$V_{ainv.p} = < 17$ kV $I_o = \leqslant 0.35$ mA $I_{op} = \leqslant 80$ mA $C_{filt} = \leqslant 5000$ pF		
EY81	6.3 0.81	For further data see PY81				
		Operating (two tubes)				
EY82 High-vacuum single anode	6.3 0.9	$V_{tr} = 2 \times 250$ V$_{rms}$ $V_o = 225$ V $I_o = 360$ mA $R_t = 2 \times 75$ Ω	$V_{tr} = 280$ V$_{rms}$ $V_o = 250$ V $I_o = 360$ mA $R_t = 2 \times 95$ Ω	$V_{tr} = 2 \times 300$ V$_{rms}$ $V_o = 268$ V $I_o = 360$ mA $R_t = 2 \times 110$ Ω	$V_{ainv.p} = 850$ V $I_o = 360$ mA $I_{ap} = 1.1$ A $V_{kfp} = 450$ V $C_{filt} = 60$ μF	
EY86-EY87	6.3 0.09	For further data see DY86–DY87				
EY88	6.3 1.55	For further data see PY88				

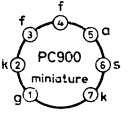
EY500A	6.3 2.1	For further data see PY500A				
		Operating				
EZ40 Double anode rectifier	6.3 0.6	$V_{tr}=2\times250$ V_{rms} $I_o=90$ mA $R_t=2\times125\ \Omega$	$V_{tr}=2\times300$ V_{rms} $I_o=90$ mA $R_t=2\times215\ \Omega$	$V_{tr}=2\times350$ V_{rms} $I_o=90$ mA $R_t=2\times300\ \Omega$	$V_{tr}=2\times350$ V_{rms} $I_o=90$ mA $C_{filt}=50\ \mu F$ $V_{kfp}=500$ V	
		Operating				
EZ41 Double anode rectifier	6.3 0.4	$V_{tr}=2\times250$ V_{rms} $V_o=253$ V	$I_o=60$ mA $R_t=2\times150\ \Omega$	$C_{filt}=8\ \mu F$	$V_{tr}=250$ V_{rms} $I_o=60$ mA $V_{kf}=350$ V	
		Operating				
EZ80 Double anode rectifier	6.3 0.6	$V_{tr}=2\times250$ V_{rms} $V_o=260$ V $I_o=90$ mA $R_t=2\times125\ \Omega$	$V_{tr}=2\times300$ V_{rms} $V_o=310$ V $I_o=90$ mA $R_t=2\times215\ \Omega$	$V_{tr}=2\times350$ V_{rms} $V_o=360$ V $I_o=90$ mA $R_t=2\times300\ \Omega$	$V_{tr}=2\times350$ V_{rms} $I_o=90$ mA $V_{kf}=500$ V $C_{filt}=50\ \mu F$	
		Operating				
EZ81 Double anode rectifier	6.3 1.0	$V_{tr}=2\times250$ V_{rms} $V_o=245$ V $I_o=160$ mA $R_t=2\times150\ \Omega$	$V_{tr}=2\times350$ V_{rms} $V_o=352$ V $I_o=150$ mA $R_t=2\times230\ \Omega$	$V_{tr}=2\times450$ V_{rms} $V_o=497$ V $I_o=100$ mA $R_t=2\times310\ \Omega$	$V_{ainvp}=1300$ V $I_{ap}=500$ mA $V_{kf}=500$ V $C_{filt}=50\ \mu F$	
		Operating				
GY501 Single-anode E.H.T. rectifier	3.15 0.4	$V_o=25$ kV	$I_a=1.5$ mA		$-V_{ap}=35$ kV [1] $V_o=27.5$ kV [1] $I_a=1.7$ mA	

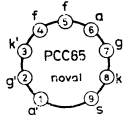
[1]) Absolute max.

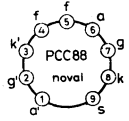
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating				
GZ34	5.0	$V_{tr}=2\times300$ V_{rms}	$V_{tr}=2\times400$ V_{rms}	$V_{tr}=2\times550$ V_{rms}	$V_{a\,invp}=1500$ V	
Double anode	1.9	$V_o=330$ V	$V_o=430$ V	$V_o=640$ V	$I_{ap}=750$ mA	
rectifier		$I_o=250$ mA	$I_o=250$ mA	$I_o=160$ mA	$C_{filt}=60$ μF	
		$R_t=2\times75\ \Omega$	$R_t=2\times125\ \Omega$	$R_t=2\times200\ \Omega$		
PABC80	9.5 0.3	For further data see UABC80				
		Typical				
PC86	3.8	$V_a=175$ V	$I_a=12$ mA	$\mu=68$	$W_a=2.2$ W	
U.H.F. triode	0.3	$V_g=-1.5$ V	$S=14$ mA/V	$R_{eq.}=230\ \Omega$	$I_k=20$ mA	
					$V_{+k/-f}=100$ V[1])	
		Typical				
PC88	3.8	$V_a=160$ V	$I_a=12.5$ mA	$\mu=65$	$W_a=2$ W	
U.H.F. triode	0.3	$R_k=100\ \Omega$	$S=13.5$ mA/V	$R_{eq.}=240\ \Omega$	$I_k=13$ mA	
					$V_{kf}=100$ V[1])	
		Typical				
PC92	3.1	$V_a=200$ V	$I_a=12$ mA	$\mu=67$	$W_a=2.5$ W	
H.F. triode	0.3	$V_g=-0.9$ V	$S=7.2$ mA/V	$R_{eq.}=400\ \Omega$	$I_k=15$ mA	
					$V_{kf}=250$ V[2])	
		$V_a=100$ V	$I_a=3$ mA	$\mu=58$		
		$V_g=-0.9$ V	$S=3.8$ mA/V			

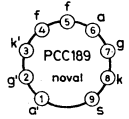
		Typical			
PC97	4.5	$V_a = 135$ V	$I_a = 11$ mA	$R_i = 5$ kΩ	$W_a = 2.2$ W
V.H.F. triode	0.3	$V_g = -1$ V	$S = 13$ mA/V	$\mu = 65$	$I_k = 20$ mA
					$V_{kf} = 100$ V
		Typical			
PC900	3.9	$V_a = 135$ V	$V_{g1} = -1$ V	$S = 14.5$ mA/V	$W_a = 2.2$ W
V.H.F. triode	0.3	$V_s = 0$ V	$I_a = 11.5$ mA	$\mu = 76$	$I_k = 20$ mA
					$V_{kf} = 100$ V
		Operating			
		$V_{ba} = 135$ V	$R_k = 0\ \Omega$	$S = 20$ mA/V	
		$V_s = 0$ V	$I_a = 16.5$ mA	$\mu = 84$	
		$R_a = 1.5$ kΩ	$I_g = 20\ \mu$A		
		Typical			
PCC85	9.0	$V_a = 170$ V	$I_a = 10$ mA	$\mu = 48$	$W_a = 2.5$ W
R.F. double	0.3	$V_g = -1.75$ V	$S = 6.7$ mA/V		$I_k = 15$ mA
triode					$V_{kf} = 90$ V
		Typical			
PCC88	7.6	$V_a = 90$ V	$I_a = 15$ mA	$\mu = 33$	$W_a = 1.8$ W
R.F. double	0.3	$V_g = -1.3$ V	$S = 12.5$ mA/V	$R_{eq.} = 300\ \Omega$	$I_k = 25$ mA
triode (cascode)					$V_{kf} = 50$ V
		Typical			
PCC189	7.6	$V_a = 90$ V	$I_a = 15$ mA	$R_i = 2.5$ kΩ	$W_a = 1.8$ W
R.F. double	0.3	$V_g = -1.4$ V	$S = 12.5$ mA/V	$\mu = 32$	$I_k = 22$ mA
triode (cascode)					$V_{kf} = 80$ V







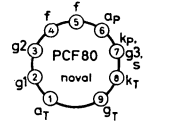


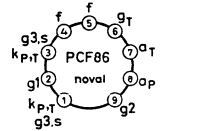


[1]) A.C. component max. 50 V_{rms}. [2]) D.C. component max. 100 V_{rms}.

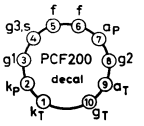
RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical (pentode)				
PCF80	9.0	$V_a = 170$ V	$I_a = 10$ mA	$R_i = 0.4$ MΩ	$W_a = 1.7$ W	
Triode-	0.3	$V_{g2} = 170$ V	$I_{g2} = 2.8$ mA	$\mu_{g2g1} = 47$	$I_k = 14$ mA	
Pentode		$V_{g1} = -2$ V	$S = 6.2$ mA/V	$R_{eq.} = 1.5$ kΩ	$V_{+k/-f} = 200$ V	
		Freq. changer (pentode)				
		$V_a = 170$ V	$R_k = 330\ \Omega$	$I_{g2} = 2$ mA		
		$V_{g2} = 170$ V	$R_{g1} = 0.1$ MΩ	$I_{g1} = 20\ \mu$A		
		$V_{osc} = 3.5\ V_{rms}$	$I_a = 6.5$ mA	$S_c = 2.2$ mA/V		
		Typical (triode)				
		$V_a = 100$ V	$I_a = 14$ mA	$R_i = 4$ kΩ	$W_a = 1.5$ W	
		$V_g = -2$ V	$S = 5$ mA/V	$\mu = 20$	$I_k = 14$ mA	
		Typical (pentode)				
PCF86	8.0	$V_a = 170$ V	$I_a = 10$ mA	$R_i = > 350$ kΩ	$W_a = 2$ W	
Triode-	0.3	$V_{g2} = 150$ V	$I_{g2} = 3.8$ mA	$\mu_{g2g1} = 70$	$I_k = 18$ mA	
pentode		$V_{g1} = -1.2$ V	$S = 12$ mA/V	$R_{eq.} = 1$ kΩ	$V_{kf} = 100$ V	
		Freq. changer (pentode)				
		$V_{ba} = 190$ V	$R_{g2} = 18$ kΩ	$I_{g2} = 3$ mA		
		$V_{bg2} = 190$ V	$R_{g1} = 0.1$ MΩ	$I_{g1} = 30\ \mu$A		
		$V_{osc} = 2.3\ V_{rms}$	$I_a = 8.5$ mA	$S_c = 4.5$ mA/V		
		Typical (triode)				
		$V_a = 100$ V	$I_a = 14$ mA	$R_i = 3$ kΩ	$W_a = 1.5$ W	
		$V_g = -3$ V	$S = 5.7$ mA/V	$\mu = 17$	$I_k = 15$ mA	

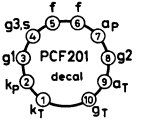




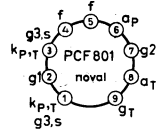
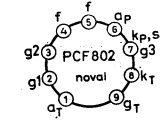
		Typical (pentode)			
PCF200	8.5	V_a = 160 V	V_{g1} = −1.7 V	S = 14 mA/V	W_a = 2.1 W
Triode	0.3	V_{g2} = 135 V	I_a = 13 mA	μ_{g2g1} = 53	I_k = 20 mA
pentode		V_{g3} = 0 V	I_{g2} = 5.3 mA		V_{kf} = 150 V
		Operating (pentode)			
		V_b = 230 V	R_k = 83 Ω	S = 14 mA/V	
		R_a = 5.6 kΩ	I_a = 12.5 mA	r_{g1} = 6.6 kΩ	
		R_{g2} = 22 kΩ	I_{g2} = 5.1 mA	(at f = 40 MHz)	
		Typical (triode)			
		V_a = 170 V	I_a = 8.5 mA	R_i = 11 kΩ	W_a = 1.5 W
		V_g = −1 V	S = 5.2 mA/V	μ = 57	I_k = 18 mA



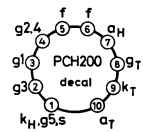
		Typical (pentode)			
PCF201	8.5	V_a = 160 V	V_{g1} = −1.4 V	S = 12.6 mA/V	W_a = 2.1 W
Triode-	0.3	V_{g2} = 110 V	I_a = 13 mA	μ_{g2g1} = 45	I_k = 20 mA
pentode		V_{g3} = 0 V	I_{g2} = 5.3 mA		V_{kf} = 150 V
		Operating (g3 to earth)			
		V_b = 250 V	R_k = 76 Ω	S = 12.6 mA/V	
		R_a = 6.8 kΩ	I_a = 12.8 mA	r_{g1} = 7.4 kΩ	
		R_{g2} = 27 kΩ	I_{g2} = 5.2 mA	(at f = 40 MHz)	
		Typical (triode)			
		V_a = 100 V	I_a = 14 mA	R_i = 3.6 kΩ	W_a = 1.5 W
		V_g = −2 V	S = 4.8 mA/V	μ = 17.5	I_k = 18 mA

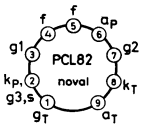


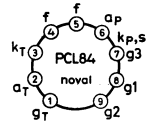
RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical (pentode)				
PCF801 Triode-pentode	8.5 0.3	V_a = 170 V V_{g2} = 120 V V_{g1} = −1.4 V	I_a = 10 mA I_{g2} = 3 mA S = 11 mA/V	R_i = >350 kΩ μ_{g2g1} = 55 $R_{eq.}$ = 1.5 kΩ	W_a = 2 W I_k = 18 mA V_{kf} = 100 V	
		Freq. changer (pentode)				
		V_{ba} = 200 V V_{bg2} = 200 V V_{osc} = 1.6 V_{rms} V_{bg1} = −1.4 V	R_a = 2·7 kΩ R_{g2} = 27 kΩ R_{g1} = 0.1 MΩ I_a = 10 mA	I_{g2} = 3 mA I_{g1} = 8 μA S_c = 5 mA/V		
		Typical (triode)				
		V_a = 100 V V_g = −3 V	I_a = 15 mA S = 9 mA/V	R_i = 2.2 kΩ μ = 20	W_a = 1.5 W I_k = 20 mA	
		Typical (pentode)				
PCF802 Triode-pentode	9.0 0.3	V_a = 100 V V_{g2} = 100 V V_{g1} = −1 V	I_a = 6 mA I_{g2} = 1.7 mA S = 5.5 mA/V	R_i = 0.4 MΩ μ_{g2g1} = 47	W_a = 1.2 W I_k = 15 mA V_{kf} = 100 V [1]	
		Typical (triode)				
		V_a = 200 V V_g = −2 V	I_a = 3.5 mA S = 3.5 mA/V	R_i = 20 kΩ μ_{g2g1} = 70	W_a = 1.4 W I_k = 10 mA	

		Typical (heptode)			
PCH200	8.5	V_a = 14 V	V_a = 14 V	V_a = 14 V	W_a = 0.5 W
Triode-	0.3	$V_{g2,g4}$ = 14 V	$V_{g2,g4}$ = 14 V	$V_{g2,g4}$ = 14 V	I_k = 8 mA
heptode		V_{g3} = 0 V	V_{g3} = 0 V	V_{g3} = −1.8 V (<2.2)	V_{kf} = 100 V
		V_{g1} = 0 V	V_{g1} = −1.8 V	V_{g1} = 0 V	
		I_a = 1.5 mA	I_a = 20 μA	I_a = 20 μA	
		I_{g2} = 1.3 mA			
		Typical (triode)			
		V_a = 100 V	S = 8.8 mA/V	V_a = 200 V	W_a = 1.5 W
		V_g = −1 V	μ = 50	V_g = −7 V (<11)	I_k = 20 mA
		I_a = 9 mA		I_a = 0.1 A	
		Operating class A (pentode)			
PCL82	16	$V_{bb} = V_{bg2}$ = 230 V	I_a = 30 mA	I_{g2} = 11 mA	W_a = 7 W
Triode	0.3	R_{g2} = 1.2 kΩ	I_{g2} = 6.6 mA	at V_i = 7.8 V_{rms}	I_k = 50 mA
output pentode		R_k = 490 Ω	at V_i = 0 V	W_a = 3.25 W	V_{kf} = 200 V
		$R_{a\sim}$ = 6 kΩ	I_a = 31 mA	d_{tot} = 10 %	
		Operating (triode)			
		V_b = 200 V	R_g = 3 MΩ	V_g/V_i = 52	W_a = 1 W
		R_a = 220 kΩ	$R_{g'}$ = 0.68 MΩ	V_o = <26 V_{rms}	I_k = 15 mA
		R_k = 2.2 kΩ	I_a = 0.52 mA	d_{tot} = 1.6 %	
		R_s = 0.22 MΩ			
		Operating (pentode)			
PCL84	15	V_b = 220 V	V_{g1} = −3.3 V	I_{g2} = 3.1 mA	W_a = 4 W
Triode	0.3	V_{g2} = 220 V	I_a = 18 mA	S = 9.7 mA/V	I_k = 40 mA
Video output		R_a = 3 kΩ			V_{kf} = 200 V
pentode		*Typical (triode)*			
		V_a = 200 V	I_a = 3 mA	μ = 65	W_a = 1 W
		V_g = 1.7 V	S = 4 mA/V		I_k = 12 mA

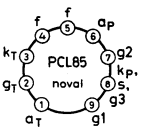
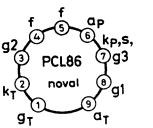
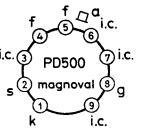
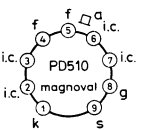




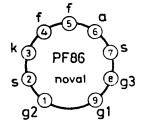


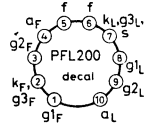
[1]) A.C. component max. 65 V_{rms}.

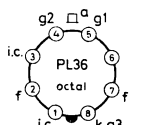
RECEIVING AND AMPLIFYING TUBES

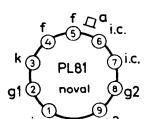
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating (pentode)				
PCL85 **PCL805** Triode-frame output pentode	17.5 0.3	V_a = 50 V V_{g2} = 170 V	V_{g1} = −1 V I_{ap} = 200 mA	I_{g2p} = 35 mA	W_a = 8 W I_k = 75 mA V_{kf} = 200 V	
		Typical (triode)				
		V_a = 100 V V_g = 0 V	I_a = 10.5 mA S = 7 mA/V	R_i = 9 kΩ μ = 63	W_a = 0.5 W I_k = 15 mA	
		Operating class A (pentode)				
PCL86 Triode-output pentode	13.3 0.3	V_a = 230 V V_{g2} = 230 V R_k = 125 Ω $R_{a\sim}$ = 5.1 kΩ	I_a = 39 mA I_{g2} = 6.5 mA at V_i = 0 V I_a = 40.7 mA	I_{g2} = 10.5 mA at V_i = 3.6 V_{rms} W_o = 4.1 W d_{tot} = 10%	W_a = 9 W I_k = 55 mA V_{kf} = 100 V	
		Operating (triode)				
		V_b = 200 V R_a = 220 kΩ R_k = 2.6 kΩ	R_g = 680 kΩ I_a = 0.42 mA V_o = 3.2 V_{rms}	V_o/V_i = 66 d_{tot} = 0.6%	W_a = 0.5 W I_k = 4 mA	
		Typical				
PD500 Shunt stabilizer triode	7.3 0.3	V_a = 25 kV V_s = 0 V	$-V_g$ (at I_a = 1.5 mA) = 7 − 30 V	$-V_g$ (at I_a = 0.1 mA) = < 40 V	W_a = 30 W I_a = 1.6 mA V_{kf} = 250 V	
		Typical				
PD510 Shunt stabilizer triode	7.3 0.3	V_a = 25 kV V_s = 0 V	$-V_g$ (at I_a = 1.5 mA) = 9 − 28 V	$-V_g$ (at I_a = 0.1 mA) = < 38 V	W_a = 30 W I_a = 1.6 mA V_{kf} = 250 V	

		Typical				
PF86	4.5	V_a = 250 V	V_{g1} = −2.2 V	S = 2.2 mA/V	W_a = 1 W	
Pentode	0.3	V_{g2} = 140 V	I_a = 3 mA	R_i = 2.5 MΩ	I_k = 4 mA	
		V_{g3} = 0 V	I_{g2} = 0.6 mA	μ_{g2g1} = 38	V_{kf} = 100 V	
		Typical (L section)				
PFL200	17	V_a = 170 V	I_a = 30 mA	R_i = 33 kΩ	W_a = 5.1 W	
Double	0.3	V_{g2} = 170 V	I_{g2} = 7 mA	μ_{g2g1} = 38	I_k = 60 mA	
pentode		V_{g1} = −2.7 V	S = 22 mA/V		V_{kf} = 200 V	
		Typical (F section)				
		V_a = 150 V	I_a = 10 mA	R_i = 150 kΩ	W_a = 1.5 W	
		V_{g2} = 150 V	I_{g2} = 3 mA	μ_{g2g1} = 38	I_k = 15 mA	
		V_{g1} = −2.1 V	S = 8.5 mA/V		V_{kf} = 200 V	
		Typical				
PL36	25	V_a = 100 V	I_a = 100 mA	R_i = 5 kΩ	W_a = 12 W	
Line	0.3	V_{g2} = 100 V	I_{g2} = 7 mA	μ_{g2g1} = 5.6	I_k = 200 mA	
output pentode		V_{g1} = −8.2 V	S = 14 mA/V		V_{kf} = 250 V	
					V_{ap} = 7 kV	
		Typical				
PL81	21.5	V_a = 170 V	V_{g1} = −24 V	S = 6.3 mA/V	W_a = 7.5 W	
Output pentode	0.3	V_{g2} = 170 V	I_a = 45 mA	R_i = 11 kΩ	I_k = 180 mA	
for line		V_{g3} = 0 V	I_{g2} = 2.4 mA	μ_{g2g1} = 5.0	V_{kf} = 200 V	
deflection					V_{ap} = 7 kV [1])	

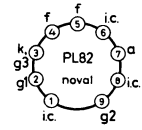
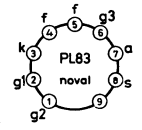
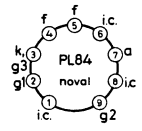
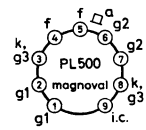


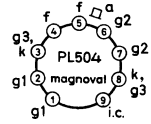
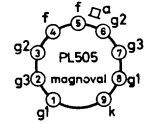
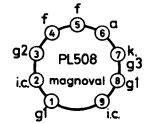
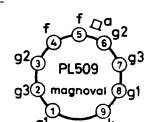






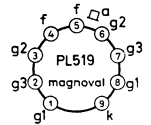
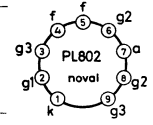
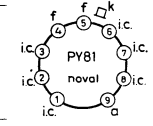
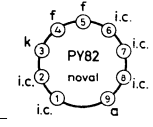
[1]) Max. pulse duration 22% of a cycle but max. 18 μs.

Type and application	V_f (V) I_f (A)	Characteristic data			Limiting values	Base connections
		Operating class A				
PL82 Frame and A.F. output pentode	16.5 0.3	$V_a = V_b = 200$ V $R_{g2} = 680\ \Omega$ $V_{g1} = -13.9$ V $I_a = 45$ mA	$I_{g2} = 8.5$ mA $S = 8.6$ mA/V $R_i = 24$ kΩ $\mu_{g2g1} = 10$	$R_{a\sim} = 4$ kΩ $W_o = 4.2$ W $V_i = 7\ V_{rms}$ $d_{tot} = 10\%$	$W_a = 9$ W $I_k = 75$ mA $V_{kf} = 200$ V $V_{ap} = 2.5$ kV	
		Typical				
PL83 Video output pentode	15 0.3	$V_a = 170$ V $V_{g2} = 170$ V $V_{g3} = 0$ V	$V_{g1} = 2.3$ V $I_a = 36$ mA $I_{g2} = 5$ mA	$S = 10.5$ mA/V $R_i = 0.1$ MΩ $\mu_{g2g1} = 24$	$W_a = 9$ W $I_k = 70$ mA $V_{kf} = 200$ V [1]	
		Operating class AB				
PL84 Frame and A.F. output pentode	15 0.3	$V_{bb} = 230$ V $V_{bg2} = 200$ V $R_k = 130\ \Omega$ $R_{aa\sim} = 4$ kΩ	$I_a = 2 \times 56$ mA $I_{g2} = 2 \times 2.3$ mA at $V_i = 0$ V $I_a = 2 \times 61$ mA	$I_{g2} = 2 \times 17.5$ mA at $V_i = 14.6\ V_{rms}$ $W_o = 17.5$ W $d_{tot} = 5.4\%$	$W_a = 12$ W $I_k = 100$ mA $V_{kf} = 200$ V $V_{ap} = 2$ kV	
PL95	4.5 0.3	For further data see EL95			$V_{kf} = 200$ V	
		Typical (dynamic)				
PL500 Line output pentode	27 0.3	$V_a = 50$ V $V_{g2} = 200$ V	$V_{g1} = -10$ V $I_a = 420$ mA	$I_{g2} = 37$ mA	$W_a = 12$ W $V_{ap} = 7$ kV $I_k = 250$ mA $V_{kf} = 250$ V	

		Typical (dynamic)				
PL504	27	V_a = 50 V	V_{g1} = −10 V	I_{g2} = 37 mA	W_a = 16 W	
Line	0.3	V_{g2} = 200 V	I_a = 420 mA		V_{ap} = 7 kV	
output pentode					I_k = 250 mA	
					V_{kf} = 250 V	
		Typical (dynamic)				
		(1)		(2)		
PL505	40	V_a = 160 V	I_a = 1.4 A	V_a = 50 V	W_a = 25 W	
Line	0.3	V_{g2} = 160 V	I_{g2} = 45 mA	V_{g2} = 175 V	V_{ap} = 7 kV	
output pentode		$V_{g1} = V_{g3} = 0$ V		V_{g1} = −10 V	I_k = 500 mA	
				I_a = 0.8 A	V_{kf} = 250 V	
		Typical (dynamic)				
		(1)		(2)		
PL508	17	$V_a = V_{g2}$ = 190 V	I_{g2} = 5 mA	V_a = 50 V	W_a = 12 W	
Frame	0.3	V_{g1} = −17 V	S = 9 mA/V	V_{g2} = 190 V	I_k = 100 mA	
output pentode		I_a = 60 mA	μ_{g2g1} = 8	V_{g1} = −1 V	V_{kf} = 220 V	
				I_{ap} = 320 mA		
				I_{g2} = 60 mA		
		Typical (dynamic)				
		(1)		(2)		
PL509	40	V_a = 160 V	I_a = 1.4 A	V_a = 50 V	W_a = 30 W	
Line	0.3	V_{g2} = 160 V	I_{g2} = 45 mA	V_{g2} = 175 V	V_{ap} = 7 kV	
output pentode		$V_{g1} = V_{g3} = 0$ V		V_{g1} = −10 V	I_k = 500 mA	
				I_a = 0.8 A	V_{kf} = 250 V	
				I_{g2} = 70 mA		

[1]) D.C. component max. 150 V

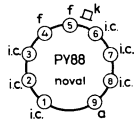
RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical (dynamic)				
		(1)		(2)		
PL519 Line output pentode	40 0.3	$V_a = 160$ V $V_{g2} = 160$ V $V_{g1} = V_{g3} = 0$ V	$I_a = 1.4$ A $I_{g2} = 45$ mA	$V_a = 70$ V $V_{g2} = 205$ V $V_{g1} = -11$ V $I_a = 1.1$ A $I_{g2} = 85$ mA	$W_a = 35$ W $V_{ap} = 7$ kV $I_k = 500$ mA $V_{kf} = 250$ V	
		Typical				
PL802 Video output pentode	16 0.3	$V_a = 170$ V $V_{g2} = 170$ V $V_{g3} = 0$ V	$V_{bg1} = 0$ V $R_k = 36\ \Omega$ $I_a = 30$ mA	$I_{g2} = 6.5$ mA $S = 40$ mA/V $\mu_{g2g1} = 70$	$W_a = 6$ W $I_k = 100$ mA $V_{kf} = 200$ V	
PM84	4.2 0.3	For further data see UM84				
		Limiting				
PY81 Booster diode	17 0.3	$V_{bo} = \leqslant 550$ V $V_b = \leqslant 250$ V $W_a = \leqslant 3.5$ W	$I_a = \leqslant 150$ mA $I_{ap} = \leqslant 450$ mA $V_{ap} = \leqslant 5$ kV [1] [2]	$V_{kfp} = < 5$ kV [1] $R_s = \geqslant 80\ \Omega$ V_f/earth $\leqslant 220\ V_{rms}$		
		Operating				
PY82 Single anode rectifier	19 0.3	$V_{tr} = 127\ V_{rms}$ $V_o = 127$ V $I_o = 180$ mA $R_t = 0\ \Omega$	$V_{tr} = 220\ V_{rms}$ $V_o = 195$ V $I_o = 180$ mA $R_t = 65\ \Omega$	$V_{tr} = 250\ V_{rms}$ $V_o = 195$ V $I_o = 180$ mA $R_t = 125\ \Omega$	$V_{a\,inv\,p} = 700$ V $I_o = 180$ mA $V_{+k/-fp} = 550$ V [3] $C_{filt} = 60\ \mu$F	

Limiting

PY88 30
Booster diode 0.3

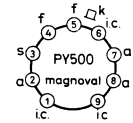
$V_{bo} = \leqslant 550$ V $\quad I_a = \leqslant 220$ mA $\quad V_{kfp} = 6.6$ kV
$V_b = \leqslant 250$ V $\quad I_{ap} = \leqslant 550$ mA $\quad R_s = \geqslant 80\ \Omega$
$W_a = \leqslant 5$ W $\quad -V_{ap} = \leqslant 6$ kV [1] $\quad V_f$/earth $\leqslant 220\ V_{rms}$



Typical and Limiting

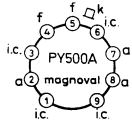
PY500 42
Booster diode 0.3

$R_i = 45.5\ \Omega$ $\quad W_a = \leqslant 11$ W $\quad -V_{ap} = 5.6$ kV [1]
$C_{kf} = 3.7$ pF $\quad I_a = \leqslant 440$ mA $\quad V_{kfp} = 6.3$ kV [1]
$C_{ak} = 13$ pF $\quad I_{ap} = \leqslant 800$ mA $\quad R_s = \geqslant 100\ \Omega$
V_f/earth $\leqslant 220\ V_{rms}$



PY500A
Booster diode

$C_{kf} = 3{,}1$ pF $\quad I_{ap} = \leqslant 1000$ mA
For further data see PY 500



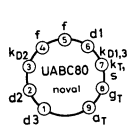
Operating (triode)

UABC80 28
Triple diode 0.1
triode

$V_b = 100$ V $\quad V_b = 170$ V $\quad V_b = 200$ V $\quad W_a = 1$ W
$R_a = 0.1$ MΩ $\quad R_a = 0.1$ MΩ $\quad R_a = 0.1$ MΩ $\quad I_k = 5$ mA
$R_{g'} = 0.33$ MΩ $\quad R_{g'} = 0.33$ MΩ $\quad R_{g'} = 0.33$ MΩ $\quad V_{kf} = 150$ V
$I_a = 0.35$ mA $\quad I_a = 0.82$ mA $\quad I_a = 1$ mA
$V_a/V_i = 35$ $\quad V_a/V_i = 42$ $\quad V_a/V_i = 44$

Typical (diodes)

R_{iD1} (at $V_{d1} = +10$ V) $= 5$ kΩ $\quad R_{iD2}$ (at $V_{d2} = +5$ V) $= 200\ \Omega$ $\quad R_{iD3}$ (at $V_{d3} = +5$ V) $= 200\ \Omega$ $\quad V_{dinvp} = 350$ V
$I_{d1} = 1$ mA
$I_{d2}, I_{d3} = 10$ mA



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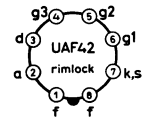
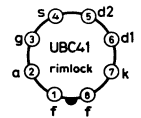
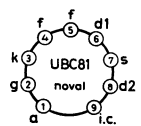
[1]) Max. pulse duration 22% of a cycle with a max. of 18 μs. [2]) Cathode pos. with respect to the anode. [3]) Max. 220 V_{rms} A.C. voltage + max. 250 V D.C. voltage.

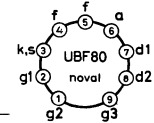
RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical (pentode)				
UAF42 Diode-pentode	12.6 0.1	$V_a = V_b = 170$ V $R_{g2} = 56$ kΩ $V_{g3} = 0$ V $V_{g1} = -2$ V	$I_a = 5$ mA $I_{g2} = 1.5$ mA $S = 2$ mA/V	$R_i = > 0.9$ MΩ $\mu_{g2g1} = 16$ $R_{eq.} = 7.5$ kΩ	$W_a = 2$ W $I_k = 10$ mA $V_{kf} = 150$ V	
		Typical (triode)				
UBC41 Double diode-triode	14 0.1	$V_a = 170$ V $V_g = -1.55$ V	$I_a = 1.5$ mA $S = 1.65$ mA/V	$R_i = 42$ kΩ $\mu = 70$	$W_a = 0.5$ W $I_k = 5$ mA $V_{kf} = 150$ V	
		Typical (triode)				
UBC81 Double diode-triode	14 0.1	$V_a = 170$ V $V_g = -1.55$ V	$I_a = 1.5$ mA $S = 1.65$ mA/V	$R_i = 42$ kΩ $\mu = 70$	$W_a = 0.5$ W $I_k = 5$ mA $V_{kf} = 100$ V	
		Operating (triode)				
		$V_b = 170$ V $R_a = 0.1$ MΩ $R_k = 3.9$ kΩ	$R_g = 1$ MΩ $R_{g'} = 0.33$ MΩ	$I_a = 0.45$ mA $V_o/V_i = 37$		

UBF80 17 — Double diode-pentode 0.1

Typical (pentode)

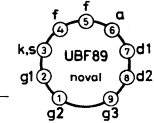
$V_a = V_b = 170$ V; $R_{g2} = 47$ kΩ; $V_{g3} = 0$ V; $V_{g1} = -2$ V; $I_a = 5$ mA; $I_{g2} = 1.75$ mA; $S = 2.2$ mA/V; $R_i = 0.9$ MΩ; $\mu_{g2g1} = 18$; $R_{eq.} = 6.2$ kΩ; $W_a = 1.5$ W; $I_k = 10$ mA; $V_{kf} = 150$ V



UBF89 19 — Double diode-pentode 0.1

Typical (pentode)

$V_a = 170$ V; $V_{g2} = 100$ V; $V_{g3} = 0$ V; $V_{g1} = -1$ V; $I_a = 12$ mA; $I_{g2} = 4$ mA; $S = 5$ mA/V; $\mu_{g2g1} = 20$; $R_i = 0.4$ MΩ; $W_a = 2.25$ W; $I_k = 16.5$ mA; $V_{kf} = 100$ V



UCC85 26 — 0.1

For further data see PCC85

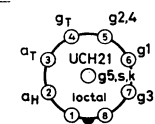
UCH21 14 — Triode-heptode 0.1

Freq. changer (heptode)

$V_a = V_b = 200$ V; $R_{g2+g4} = 15.5$ kΩ; $R_{gT+g3} = 50$ kΩ; $V_{g1} = -2$ V; $I_a = 5.2$ mA; $I_{g2+g4} = 3.5$ mA; $I_{gT+g3} = 0.19$ mA; $S_c = 0.75$ mA/V; $R_i = 1$ MΩ; $R_{eq.} = 55$; $W_a = 1.5$ W; $I_k = 15$ mA; $V_{kf} = 150$ V

Oscillator (triode)

$V_b = 200$ V; $R_a = 20$ kΩ; $R_{gT+g3} = 50$ kΩ; $I_{gT+g3} = 0.19$ mA; $I_a = 4.1$ mA; $S_{eff} = 0.45$ mA/V



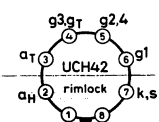
UCH42 14 — Triode-hexode 0.1

Freq. changer (hexode)

$V_b = 170$ V; $R_1 = 18$ kΩ; $R_2 = 27$ kΩ; $R_{gT+g3} = 22$ kΩ; $V_{g1} = -1.85$ V; $I_a = 2.1$ mA; $I_{g2+g4} = 2.6$ mA; $I_{gT+g3} = 0.35$ mA; $S_c = 0.67$ mA/V; $R_i = > 1$ MΩ; $R_{eq.} = 65$ kΩ; $W_a = 1.5$ W; $I_k = 10$ mA; $V_{kf} = 150$ V

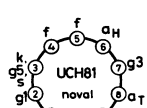
Oscillator (triode)

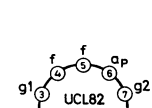
$V_b = 170$ V; $R_a = 10$ kΩ; $R_{gT+g3} = 22$ kΩ; $I_{gT+g3} = 0.35$ mA; $I_a = 6.5$ mA; $S_{eff} = 0.75$ mA/V; $W_a = 0.8$ W; $I_k = 7$ mA

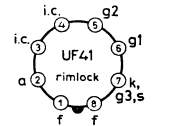
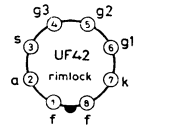
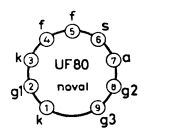
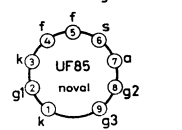
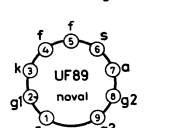


RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Freq. changer (heptode)				
UCH81	19	V_b = 170 V	I_a = 3.3 mA	S_c = 1.1 mA/V	W_a = 1.8 W	
Triode	0.1	R_{g2+g4} = 10 kΩ	I_{g2+g4} = 8.2 mA	R_i = 0.8 MΩ	I_k = 18 mA	
heptode		R_{gT+g3} = 47 kΩ	I_{gT+g3} = 0.2 mA	$R_{eq.}$ = 30 kΩ	V_{kf} = 100 V	
		I_{g1} = 0.5 μA [1])				
		Operating (heptode)				
		V_b = 170 V	I_a = 8 mA	R_i = 0.4 MΩ		
		R_{g2+g4} = 18 kΩ	I_{g2+g4} = 5 mA	μ_{g2g1} = 25		
		V_{g3} = 0 V	S = 3.9 mA/V	$R_{eq.}$ = 4 kΩ		
		I_{g1} = 0.5 μA [1])				
		Oscillator (triode)				
		V_b = 170 V	R_{gT+g3} = 47 kΩ	I_a = 4.5 mA	W_a = 0.8 W	
		R_a = 15 kΩ	I_{gT+g3} = 0.2 mA	S_{eff} = 0.65 mA/V	I_k = 6.5 mA	
					V_{kf} = 100 V	
		Operating class A (pentode)				
UCL82	50	$V_{ba} = V_{bg2}$ = 200 V	I_a = 35 mA	I_{g2} = 13.3 mA	W_a = 7 W	
Triode	0.1	R_{g2} = 470 Ω	I_{g2} = 7.8 mA	at V_i = 6.7 V_{rms}	I_k = 50 mA	
output pentode		R_k = 330 Ω	at V_i = 0 V	W_o = 3.3 W	V_{kf} = 200 V	
		$R_{a\sim}$ = 4.5 kΩ	I_a = 37 mA	d_{tot} = 10%		
		Operating (triode)				
		V_b = 170 V	R_g = 3 MΩ	V_a/V_i = 51	W_a = 1 W	
		R_a = 220 kΩ	$R_{g'}$ = 0.68 MΩ	V_o = <25 V_{rms}	I_k = 15 mA	
		R_k = 2.7 kΩ	I_a = 0.43 mA	d_{tot} = 2.3%	V_{kf} = 200 V	
		R_s = 0.22 MΩ				

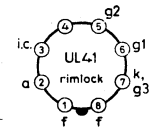
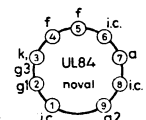
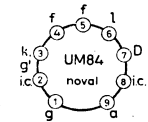




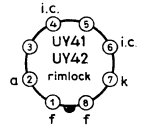
		Typical				
UF41	12.6	V_b = 170 V	I_a = 6 mA	R_i = 1 MΩ	W_a = 2 W	
R.F. pentode	0.1	R_{g2} = 40 kΩ	I_{g2} = 1.75 mA	μ_{g2g1} = 18	I_k = 10 mA	
		V_{g1} = −2.5 V	S = 2.2 mA/V	$R_{eq.}$ = 6.5 kΩ	V_{kf} = 150 V	
		Typical				
UF42	21	V_a = 170 V	I_a = 10 mA	R_i = 300 kΩ	W_a = 2 W	
R.F. pentode	0.1	V_{g2} = 170 V	I_{g2} = 2.8 mA	μ_{g2g1} = 52	I_k = 15 mA	
		V_{g3} = 0 V	S = 8 mA/V	$R_{eq.}$ = 1.06 kΩ	V_{kf} = 150 V	
		V_{g1} = −2 V				
		Typical				
UF80	19	V_a = 170 V	I_a = 10 mA	R_i = 0.4 MΩ	W_a = 2.5 W	
R.F. pentode	0.1	V_{g2} = 170 V	I_{g2} = 2.5 mA	μ_{g2g1} = 50	I_k = 15 mA	
		V_{g3} = 0 V	S = 7.4 mA/V	$R_{eq.}$ = 1.0 kΩ	V_{kf} = 150 V	
		V_{g1} = −2 V				
		Typical				
UF85	19	$V_a = V_b$ = 170 V	I_a = 9.7 mA	R_i = 0.3 MΩ	W_a = 2.5 W	
R.F. pentode	0.1	R_{g2} = 27 kΩ	I_{g2} = 2.6 mA	$R_{eq.}$ = 1.4 kΩ	I_k = 15 mA	
		V_{g3} = 0 V	S = 5.9 mA/V		V_{kf} = 150 V	
		V_{g1} = −2 V				
		Typical				
UF89	12.6	$V_a = V_b$ = 170 V	I_a = 11 mA	R_i = 0.45 MΩ	W_a = 2.25 W	
R.F. pentode	0.1	R_{g2} = 15 kΩ	I_{g2} = 3.9 mA	$R_{eq.}$ = 4.5 kΩ	I_k = 16.5 mA	
		V_{g3} = 0 V	S = 3.8 mA/V		V_{kf} = 150 V	
		V_{g1} = −1.95 V				

[1]) Grid current bias obtained with R_{g1} = 1 MΩ and with zero volts a.g.c. voltage; resulting grid No 1 voltage: −0.5 V.

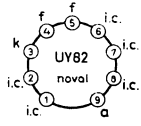
RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating class A				
UL41 A.F. output pentode	45 0.1	V_a = 170 V V_{g2} = 170 V V_{g1} = −10.4 V I_a = 53 mA	I_{g2} = 10 mA S = 9.5 mA/V R_i = 20 kΩ μ_{g2g1} = 10	$R_{a\sim}$ = 3 kΩ V_i = 6 V_{rms} W_o = 4 W d_{tot} = 10%	W_a = 9 W I_k = 75 mA V_{kf} = 150 V	
		Operating class A				
UL84 A.F. output pentode	45 0.1	V_a = 170 V V_{g2} = 170 V V_{g1} = −12.5 V I_a = 70 mA	I_{g2} = 3.5 mA S = 11 mA/V R_i = 26 kΩ μ_{g2g1} = 8	$R_{a\sim}$ = 2 kΩ V_i = 6.1 V_{rms} W_o = 5.1 W d_{tot} = 10%	W_a = 12 W I_k = 100 mA V_{kf} = 200 V	
		Operating				
UM84 Tuning indicator	12 0.1	$V_b = V_i$ = 170 V R_{gD} = 470 kΩ R_g = 3 MΩ	V_{bg} = 0 V I_{a+D} = 0.3 mA I_i = 0.6 mA α = 20 mm	V_{bg} = −15 V I_{a+D} = 0.04 mA I_i = 1.05 mA α = 0 mm	W_a = 0.5 W I_k = 3 mA V_{+ki-f} = 250 V	

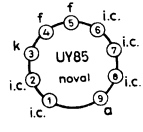
		Operating			
UY41-UY42	31	$V_{tr} = 127\ V_{rms}$	$V_{tr} = 220\ V_{rms}$	$V_{tr} = 250\ V_{rms}$	$V_{a\,invp} = 700\ V$
Single anode	0.1	$V_o = 135\ V$	$V_o = 188\ V$	$V_o = 205\ V$	$I_{ap} = 660\ mA$
rectifiers		$I_o = 100\ mA$	$I_o = 100\ mA$	$I_o = 100\ mA$	$V_{kfp} = 550\ V$
		$R_t = 0\ \Omega$	$R_t = 160\ \Omega$	$R_t = 210\ \Omega$	$C_{filt} = 50\ \mu F$



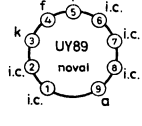
		Operating			
UY82	55	$V_{tr} = 127\ V_{rms}$	$V_{tr} = 220\ V_{rms}$	$V_{tr} = 250\ V_{rms}$	$V_{a\,invp} = 700\ V$
Single anode	0.1	$V_o = 127\ V$	$V_o = 195\ V$	$V_o = 195\ V$	$I_{ap} = 1.1\ A$
rectifier		$I_o = 180\ mA$	$I_o = 180\ mA$	$I_o = 180\ mA$	$V_{kfp} = 550\ V$
		$R_t = 0\ \Omega$	$R_t = 65\ \Omega$	$R_t = 125\ \Omega$	$C_{filt} = 60\ \mu F$



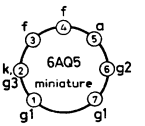
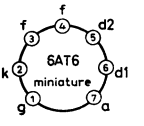
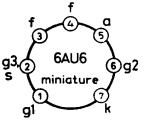
		Operating			
UY85	38	$V_{tr} = 127\ V_{rms}$	$V_{tr} = 220\ V_{rms}$	$V_{tr} = 250\ V_{rms}$	$V_{a\,invp} = 700\ V$
Single anode	0.1	$V_o = 135\ V$	$V_o = 215\ V$	$V_o = 245\ V$	$I_{ap} = 660\ mA$
rectifier		$I_o = 110\ mA$	$I_o = 110\ mA$	$I_o = 110\ mA$	$V_{kfp} = 550\ V$
		$R_t = 0\ \Omega$	$R_t = 90\ \Omega$	$R_t = 100\ \Omega$	$C_{filt} = 100\ pF$



		Operating			
UY89	31	$V_{tr} = 127\ V_{rms}$	$V_{tr} = 220\ V_{rms}$	$V_{tr} = 250\ V_{rms}$	$V_{a\,invp} = 700\ V$
Single anode	0.1	$V_o = 135\ V$	$V_o = 188\ V$	$V_o = 205\ V$	$I_{ap} = 600\ mA$
rectifier		$I_o = 100\ mA$	$I_o = 100\ mA$	$I_o = 100\ mA$	$V_{kfp} = 550\ V$
		$R_t = 0\ \Omega$	$R_t = 160\ \Omega$	$R_t = 210\ \Omega$	$C_{filt} = 50\ \mu F$

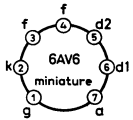


RECEIVING AND AMPLIFYING TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating class A				
6AQ5 Output pentode	6.3 0.45	V_a = 250 V V_{g2} = 250 V V_{g1} = −12.5 V I_a = 45 mA	I_{g2} = 4.5 mA S = 4.1 mA/V R_i = 52 kΩ $R_{a\sim}$ = 5 kΩ	I_a = 47 mA I_{g2} = 7 mA W_o = 4.5 W V_i = 8.8 V_{rms} d_{tot} = 8 %	W_a = 12 W V_{kf} = 100 V	
		Typical (triode)				
6AT6 Double diode Triode	6.3 0.3	V_a = 250 V V_g = −3 V V_a = 100 V V_g = −1 V	I_a = 1 mA S = 1.2 mA/V I_a = 0.8 mA S = 1.3 mA/V	R_i = 58 kΩ μ = 70 R_i = 54 kΩ μ = 70	W_a = 0.5 W V_{kfp} = 90 V	
		Typical				
6AU6 Sharp cut-off pentode	6.3 0.3	V_a = 250 V V_{g2} = 150 V V_{g1} = −1 V	V_{g3} = 0 V I_a = 10.6 mA I_{g2} = 4.3 mA	S = 5.2 mA/V R_i = 1 MΩ	W_a = 3.5 W V_{kf} = 100 V	

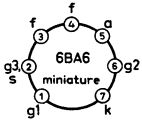
Typical (triode)

6AV6	6.3	$V_a = 250$ V	$I_a = 1.2$ mA	$R_i = 62.5$ kΩ	$W_a = 0.55$ W
Double diode	0.3	$V_g = -2$ V	$S = 1.6$ mA/V	$\mu = 100$	$V_{kf} = 100$ V
Triode					



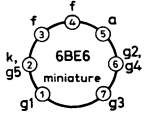
Typical

6BA6	6.3	$V_a = 250$ V	$R_k = 68\ \Omega$	$S = 4.4$ mA/V	$W_a = 3.4$ W
Remote cut-off	0.3	$V_{g2} = 100$ V	$I_a = 11$ mA	$R_i = 1$ MΩ	$V_{kf} = 100$ V
pentode		$V_{g3} = 0$ V	$I_{g2} = 4.2$ mA	$R_{eq.} = 4$ kΩ	



Operating

6BE6	6.3	$V_a = 250$ V	$R_{g1} = 20$ kΩ	$I_{g1} = 0.5\ \mu$A	$W_a = 1.1$ W
Heptode	0.3	$V_{g2+g4} = 100$ V	$I_a = 2.9$ mA	$S_c = 475\ \mu$A/V	$I_k = 20$ mA
		$V_{g3} = -1.5$ V	$I_{g2+g4} = 6.8$ mA	$R_i = 1$ MΩ	$V_{kf} = 100$ V

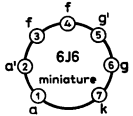


Typical

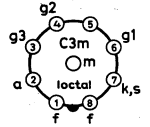
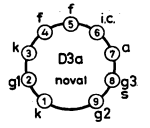
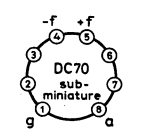
6J6	6.3	$V_a = 100$ V	$R_k = 100\ \Omega$	$R_i = 7.1$ kΩ	$W_a = 1.5$ W
Double	0.45	$I_a = 8.5$ mA	$S = 5.3$ mA/V	$\mu = 38$	$I_k = 25$ mA
triode					$V_{kf\,p} = 100$ V

Operating

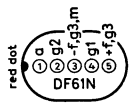
$V_a = 150$ V	$I_a = 2 \times 15$ mA	$W_{ig} = 0.35$ W
$V_g = -10$ V	$I_g = 2 \times 8$ mA	$W_o = 3.5$ W
$R_g = 625\ \Omega$		

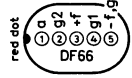


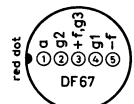
SPECIAL QUALITY TUBES

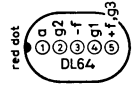
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
C3m A.F.–R.F. output pentode	20 0.125	*Operating* V_{ba} = 225 V V_{bg2} = 155 V V_{g3} = 0 V R_k = 250 Ω	I_a = 16 mA I_{g2} = 3 mA S = 6.5 mA/V R_i = 250 kΩ	μ_{g2g1} = 19 $R_{a\sim}$ = 10 kΩ W_o = 1.5 W d_{tot} = 10%	W_a = 4 W I_k = 30 mA V_{kf} = 120 V	
D3a Wide band pentode	6.3 0.315	*Typical* V_{ba} = 190 V V_{bg2} = 160 V V_{g3} = 0 V V_{bg1} = +10 V	R_k = 400 Ω I_a = 22 mA I_{g2} = 6 mA S = 35 mA/V	R_i = 120 kΩ μ_{g2g1} = 80 $R_{eq.}$ = 150 Ω	W_a = 4.2 W I_k = 30 mA V_{kf} = 60 V	
DC70 U.H.F. Osc. triode	1.25 0.2	*Typical* V_a = 150 V V_g = −4.5 V *Oscillator* V_a = 150 V I_k = 20 mA	I_a = 12 mA S = 3.4 mA/V W_o = 0.45 W	R_i = 4 kΩ μ = 14 f = 500 MHz	W_a = 2.4 W I_k = 20 mA I_g = 5 mA	

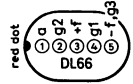
		Typical				
DF61N	1.25	V_a = 67.5 V	I_a = 1.7 mA	R_i = 1 MΩ	I_k = 2.5 mA	
R.F. pentode	0.025	V_{g2} = 67.5 V	I_{g2} = 0.45 mA	μ_{g2g1} = 21	C_{ag1} = 0.01 pF	
		V_{g1} = 0 V	S = 0.95 mA/V			
		Operating				
DF66	0.625	V_b = 22.5 V	V_{g1} = −0.62 V	I_k = 16 μA	V_a = 45 V	
A.F. pentode	0.015	R_a = 1 MΩ	R_{g1} = 5 MΩ	V_o/V_i = 33	V_{g2} = 45 V	
		R_{g2} = 2 MΩ	$R_{g1'}$ = 5 MΩ		I_k = 100 μA	
		Operating				
DF67	0.625	V_b = 22.5 V	V_{g1} = 0 V	I_a = 11.7 μA	W_a = 1.5 mW	
A.F. pentode	0.133	R_a = 1 MΩ	R_{g1} = 10 MΩ	I_{g2} = 2.5 μA	I_k = 75 μA	
		R_{g2} = 3.3 MΩ	$R_{g1'}$ = 5 MΩ	V_o/V_i = 31	R_{g1} = 10 MΩ	
		Operating				
DL64	1.25	V_b = 15 V	I_a = 160 μA	R_i = 0.4 MΩ	V_a = 45 V	
Output pentode	0.01	V_{g2} = 15 V	I_{g2} = 40 μA	$R_{a\sim}$ = 0.1 MΩ	V_{g2} = 45 V	
		V_{g1} = −1.5 V	S = 180 μA/V	W_o = 0.95 mW	I_k = 0.6 mA	
		Operating				
DL66	1.25	V_b = 22.5 V	I_a = 300 μA	R_i = 0.3 MΩ	V_a = 45 V	
Output pentode	0.015	V_{g2} = 22.5 V	I_{g2} = 75 μA	$R_{a\sim}$ = 75 kΩ	V_{g2} = 45 V	
		V_{g1} = −1.4 V	S = 350 μA/V	W_o = 2.7 mW	I_k = 1 mA	

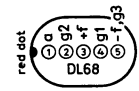
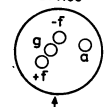
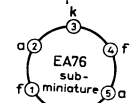
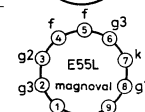
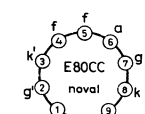


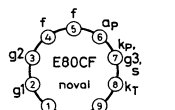
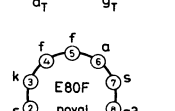
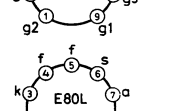
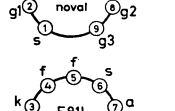
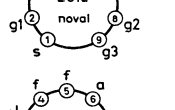




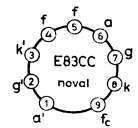
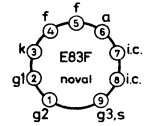
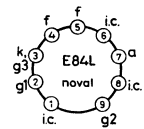


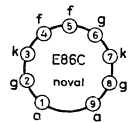
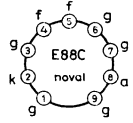
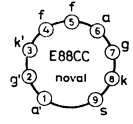
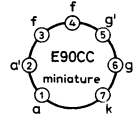
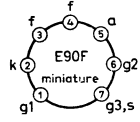


Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating				
DL68 Output pentode	1.25 0.025	V_a = 22.5 V V_{g2} = 22.5 V V_{g1} = −2.2 V	$R_{a\sim}$ = 37.5 kΩ I_a = 600 μA I_{g2} = 150 μA	V_i = 1.3 V_{rms} W_o = 5 mW d_{tot} = 10 %	W_a = 0.1 W W_{g2} = 0.025 W I_k = 2.3 mA	
		Operating				DM160
DM160 Computer indicator	1.0 0.03	V_a = 50 V R_g = 0.1 MΩ	V_{bg} = 0 V I_a = 585 μA	V_{bg} = −3 V I_a = < 5 μA	V_a = 100 V I_a = 850 μA R_g = ⩽ 1.1 MΩ R_g = ⩾ 0.09 MΩ	
		Operating and limiting				
EA76 Diode	6.3 0.15	$V_{d\,invp}$ = ⩽ 420 V	I_d = ⩽ 9 mA	I_{dp} = ⩽ 54 mA		
		Typical				
E55L Wide band Output pentode	6.3 0.6	V_a = 125 V V_{g2} = 125 V V_{g1} = −3 V	V_{g3} = 0 V I_a = 50 mA I_{g2} = 5.5 mA	S = 45 mA/V R_i = 20 kΩ μ_{g2g1} = 30	W_a = 10 W I_k = 75 mA V_{kf} = 200 V	
		Typical				
E80CC Double triode	6.3 0.6 or 12.6 0.3	V_a = 250 V R_k = 920 Ω	I_a = 6 mA S = 2.7 mA/V	R_i = 10 kΩ μ = 2.7	W_a = 2 W I_k = 12 mA V_{kf} = 120 V	

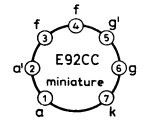
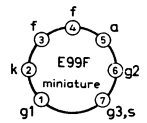
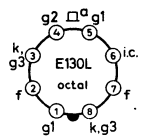
		Typical (pentode)				
E80CF	6.3	$V_{ba} = 170$ V	$I_a = 10$ mA	$R_i = 0.4$ MΩ	$W_a = 2.15$ W	
Triode	0.33	$V_{bg2} = 170$ V	$I_{g2} = 2.8$ mA	$\mu_{g2g1} = 40$	$I_k = 18$ mA	
pentode		$R_k = 155\ \Omega$	$S = 6.2$ mA/V		$V_{kf} = 100$ V	
		Typical (triode)				
		$V_{ba} = 100$ V	$I_a = 14$ mA	$R_i = 3.6$ kΩ	$W_a = 1.75$ W	
		$R_k = 120\ \Omega$	$S = 5$ mA/V	$\mu = 18$	$I_k = 18$ mA	
		Operating				
E80F	6.3	$V_{ba} = 250$ V	$R_k = 1.5$ kΩ	$I_a = 0.8$ mA	$W_a = 1.3$ W	
A.F. pentode	0.3	$V_{bg2} = 250$ V	$R_{g1} = 1$ MΩ	$I_{g2} = 0.17$ mA	$I_k = 9$ mA	
		$R_a = 0.22$ MΩ	$R_{g1'} = 0.68$ MΩ	$V_o/V_i = 175$	$V_{+k/-f} = 120$ V	
		$R_{g2} = 1.2$ MΩ			$V_{-k/+f} = 60$ V	
		Operating class A				
E80L	6.3	$V_a = 200$ V	$I_a = 30$ mA	$R_{a\sim} = 7$ kΩ	$W_a = 8$ W	
Output	0.7	$V_{g2} = 200$ V	$I_{g2} = 4.1$ mA	$W_o = 2.7$ W	$I_k = 50$ mA	
pentode		$V_{g3} = 0$ V	$S = 9$ mA/V	$d_{tot} = 10\%$	$V_{kf} = 120$ V	
		$R_k = 130\ \Omega$	$R_i = 52$ kΩ			
		Operating class A				
E81L	6.3	$V_a = 210$ V	$R_k = 120\ \Omega$	$I_{g2} = 5.3$ mA	$W_a = 4.5$ W	
Output	0.375	$V_{g2} = 210$ V	$R_{a\sim} = 15$ kΩ	$W_o = 1$ W	$I_k = 30$ mA	
pentode		$V_{g3} = 0$ V	$I_a = 20$ mA	$d_{tot} = 5\%$	$V_{kf} = 120$ V	
		Typical				
E82CC	6.3	$V_a = 250$ V	$I_a = 10.5$ mA	$R_i = 7.7$ kΩ	$W_a = 3$ W	
Double	0.3	$R_k = 800\ \Omega$	$S = 2.2$ mA/V	$\mu = 17$	$I_k = 22$ mA	
triode	or 12.6				$V_{kf} = 100$ V	
	0.15					

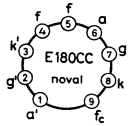
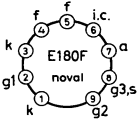
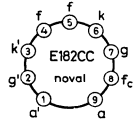
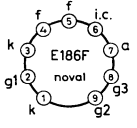
SPECIAL QUALITY TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical				
E83CC Double triode	6.3 0.3 or 12.6 0.15	$V_a = 250$ V $R_k = 1.6$ kΩ	$I_a = 1.25$ mA $S = 1.6$ mA/V	$R_i = 62.5$ kΩ $\mu = 100$	$W_a = 1.2$ W $I_k = 9$ mA $V_{kf} = 200$ V	
		Typical				
E83F Pentode	6.3 0.3	$V_a = 210$ V $V_{g2} = 120$ V $V_{g3} = 0$ V $R_k = 165\ \Omega$	$I_a = 10$ mA $I_{g2} = 2.1$ mA $S = 9$ mA/V	$R_i = 0.5$ MΩ $\mu_{g2g1} = 38$ $R_{eq.} = 750\ \Omega$	$W_a = 2.1$ W $I_k = 16$ mA $V_{kf} = 100$ V	
		Operating class A				
E84L Output pentode	6.3 0.76	$V_a = 250$ V $V_{g2} = 250$ V $R_k = 135\ \Omega$ $I_a = 48$ mA	$I_{g2} = 5.5$ mA $S = 11.3$ mA/V $R_i = 40$ kΩ $\mu_{g2g1} = 19$	$R_{a\sim} = 4.5$ kΩ $W_o = 5.7$ W $d_{tot} = 10\%$ $V_i = 4.4\ V_{rms}$	$W_a = 13.5$ W $I_k = 75$ mA $V_{kf} = 100$ V	
		Class B $V_a = 300$ V $V_{g2} = 300$ V $V_{g1} = -14.7$ V $R_{aa\sim} = 8$ kΩ	$I_a = 2 \times 7.5$ mA $I_{g2} = 2 \times 0.8$ mA at $V_i = 0$ V $I_a = 2 \times 46$ mA	$I_{g2} = 2 \times 11$ mA at $V_i = 10\ V_{rms}$ $W_o = 17$ W $d_{tot} = 4\%$		

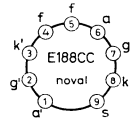
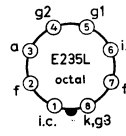
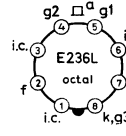
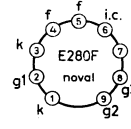
		Typical				
E86C U.H.F. triode	6.3 0.165	$V_{ba} = 185$ V $V_{bg} = +8$ V $R_k = 800\ \Omega$	$I_a = 12$ mA $S = 14$ mA/V $R_i = 4.8$ kΩ	$\mu = 68$ $R_{eq.} = 250\ \Omega$	$W_a = 2.4$ W $I_k = 20$ mA $V_{kf} = 100$ V $f = 800$ MHz	
E88C U.H.F. triode	6.3 0.165	$V_a = 160$ V $V_g = -1.25$ V $I_a = 12.5$ mA	$S = 13.5$ mA/V $R_i = 5.2$ kΩ $\mu = 70$	$R_{eq.} = 240\ \Omega$ $F = 9.6$ dB at $f = 850$ MHz	$W_a = 2.6$ W $I_k = 16.5$ mA $V_{+k/-f} = 125$ V $V_{-k/+f} = 60$ V	
E88CC Double triode	6.3 0.3	$V_{ba} = 100$ V $V_{bg} = +9$ V $R_k = 680\ \Omega$	$I_a = 15$ mA $S = 12.5$ mA/V $\mu = 33$	$R_{eq.} = 300\ \Omega$ $F = 4.6$ dB at $f = 200$ MHz	$W_a = 1.8$ W $I_k = 20$ mA $V_{+k/-f} = 150$ V $V_{-k/+f} = 100$ V	
E90CC Double triode computer application	6.3 0.4	$V_a = 100$ V $V_g = -2.1$ V	$I_a = 8.5$ mA $S = 6$ mA/V	$R_i = 4.5$ kΩ $\mu = 27$	$W_a = 2$ W $I_k = 15$ mA $V_{kf} = 100$ V	
E90F Sharp cut-off pentode	6.3 0.15	$V_{ba} = 250$ V $V_{g2} = 150$ V $V_{g3} = 0$ V $R_k = 100\ \Omega$	$I_a = 7.4$ mA $I_{g2} = 2.9$ mA $S = 4.6$ mA/V	$R_i = 1.3$ MΩ $\mu_{g2g1} = 48$ $R_{eq.} = 2.5$ kΩ	$W_a = 2.6$ W $I_k = 15$ mA $V_{kf} = 100$ V	

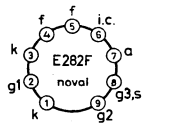
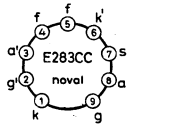
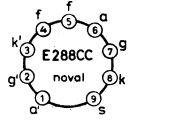
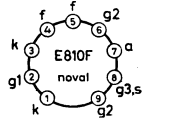
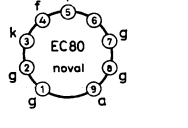
SPECIAL QUALITY TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical				
E92CC Double triode computer application	6.3 0.4	V_a = 150 V V_g = −1.7 V	I_a = 8.5 mA S = 6 mA/V	R_i = 7.5 kΩ μ = 45	W_a = 2 W I_k = 5 mA V_{kf} = 100 V	
		Typical				
E99F Remote cut-off pentode	6.3 0.15	V_{ba} = 250 V V_{bg2} = 100 V V_{g3} = 0 V R_k = 80 Ω	I_a = 9.2 mA I_{g2} = 3.3 mA S = 3.8 mA/V	R_i = 1 MΩ μ_{g2g1} = 25 $R_{eq.}$ = 3.5 kΩ	W_a = 3.3 W I_k = 17 mA V_{kf} = 100 V	
		Operating class A				
E130L Output pentode	6.3 1.7	V_a = 250 V V_{g2} = 150 V V_{g1} = −15.5 V	$R_{a\sim}$ = 2.7 kΩ V_i = 3.8 V_{rms} I_a = 100 mA	I_{g2} = 18 mA W_o = 11.5 W d_{tot} = 10%	W_a = 27.5 W I_k = 300 mA $V_{+k/f\sim}$ = 200 V $V_{-k/f+}$ = 100 V	
		Class AB				
		V_a = 300 V V_{g2} = 150 V V_{g1} = −17 V $R_{aa\sim}$ = 1.6 kΩ	I_a = 2 × 80 mA I_{g2} = 2 × 2.5 mA at V_i = 0 V I_a = 2 × 182 mA	I_{g2} = 2 × 22 mA at V_i = 9 V_{rms} W_o = 60 W d_{tot} = 5%		

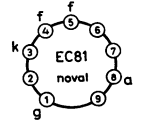
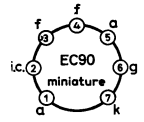
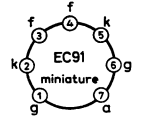
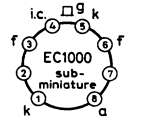
		Typical				
E180CC Double triode computer application	6.3 0.4 or 12.6 0.2	$V_a = 150$ V $V_g = -1.85$ V	$I_a = 8.5$ mA $S = 6.4$ mA/V	$R_i = 7.2$ kΩ $\mu = 46$	$W_a = 2$ W $I_k = 20$ mA $V_{+k/f-} = 200$ V $V_{-k/f+} = 100$ V	
		Typical				
E180F Wide band pentode	6.3 0.3	$V_{ba} = 190$ V $V_{bg2} = 160$ V $V_{g3} = 0$ V $V_{bg1} = +9$ V	$R_k = 630$ Ω $I_a = 13$ mA $I_{g2} = 3.3$ mA $S = 16.5$ mA/V	$R_i = 90$ kΩ $\mu_{g2g1} = 50$ $R_{eq.} = 330$ Ω	$W_a = 3$ W $I_k = 25$ mA $V_{kf} = 60$ V	
		Typical				
E182CC Double triode computer application	6.3 0.64 or 12.6 0.32	$V_a = 120$ V $V_g = -2$ V	$I_a = 36$ mA $S = 15$ mA/V	$R_i = 1.6$ kΩ $\mu = 24$	$W_a = 4.5$ W $I_k = 60$ mA $V_{kf} = 200$ V	
		Typical				
E186F Wide band pentode	6.3 0.32	$V_{ba} = 190$ V $V_{bg2} = 160$ V $V_{g3} = 0$ V $V_{bg1} = +9$ V	$R_k = 630$ Ω $I_a = 13$ mA $I_{g2} = 3.3$ mA $S = 16.5$ mA/V	$R_i = 100$ kΩ $\mu_{g2g1} = 53$ $R_{eq.} = 330$ Ω	$W_a = 3$ W $I_k = 25$ mA $V_{kf} = 60$ V	

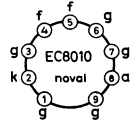
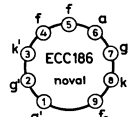
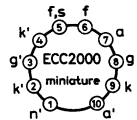
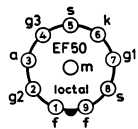
SPECIAL QUALITY TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical				
E188CC Double triode	6.3 0.335	V_{ba} = 100 V V_{bg} = +9 V R_k = 680 Ω	I_a = 15 mA S = 12.5 mA/V μ = 33	$R_{eq.}$ = 250 Ω F = 4.6 dB at f = 200 MHz	W_a = 1.65 W I_k = 22 mA $V_{+k/-f}$ = 150 V $V_{-k/+f}$ = 100 V	
		Typical				
E235L Output pentode	6.3 1.2	V_a = 100 V V_{g2} = 100 V R_k = 75 Ω	I_a = 100 mA I_{g2} = 5.2 mA S = 14 mA/V	R_i = 5 kΩ μ_{g2g1} = 5.6	W_a = 15 W I_k = 220 mA $V_{+k/-f}$ = 250 V $V_{-k/+f}$ = 200 V	
		Typical				
E236L Output pentode	6.3 1.2	V_a = 100 V V_{g2} = 100 V R_k = 75 Ω	I_a = 100 mA I_{g2} = 5.2 mA S = 14 mA/V	R_i = 5 kΩ μ_{g2g1} = 5.6	W_a = 15 W I_k = 220 mA V_{g_p} = 7 kV $V_{+k/-f}$ = 250 V	
		Typical				
E280F Wide band pentode	6.3 0.315	V_{ba} = 190 V V_{bg2} = 160 V V_{g3} = 0 V V_{bg1} = +8 V	R_k = 370 Ω I_a = 20 mA I_{g2} = 6 mA S = 26 mA/V	R_i = 100 kΩ μ_{g2g1} = 60 $R_{eq.}$ = 220 Ω	W_a = 4 W I_k = 30 mA $V_{+k/-f}$ = 120 V $V_{-k/+f}$ = 60 V	

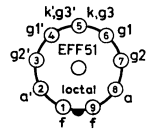
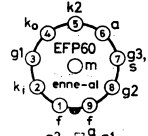
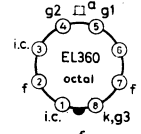
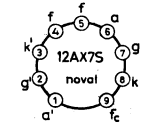
		Typical				
E282F	6.3	V_{ba} = 125 V	R_k = 300 Ω	μ_{g2g1} = 27	W_a = 4.2 W	
Wide band	0.35	V_{bg2} = 125 V	I_a = 35 mA	$R_{eq.}$ = 200 Ω	I_k = 50 mA	
pentode		V_{g3} = 0 V	I_{g2} = 11 mA	F = 7 dB	V_{kf} = 100 V	
		V_{bg1} = +12 V	S = 26 mA/V	at f = 100 MHz		
		Typical				
E283CC	6.3	V_a = 250 V	I_a = 1.25 mA	R_i = 62.5 kΩ	W_a = 1.2 W	
A.F. double	0.33	R_k = 1.6 kΩ	S = 1.6 mA/V	μ = 100	I_k = 9 mA	
triode					V_{kf} = 200 V	
		Operating				
		V_{ba} = 250 V	R_o = 150 kΩ	V_o/V_i = 37.5		
		R_a = 47 kΩ	I_a = 1.18 mA	d_{tot} = 7%		
		R_k = 1.2 kΩ	V_o = 23 V_{rms}			
		Typical				
E288CC	6.3	V_{ba} = 100 V	I_a = 30 mA	μ = 25	W_a = 3 W	
R.F. double	0.475	V_{bg} = +9 V	S = 20 mA/V	$R_{eq.}$ = 200 Ω	I_k = 40 mA	
triode		R_k = 350 Ω	R_i = 1.25 kΩ	F = 5.7 dB	V_{kf} = 150 V	
		Typical				
E810F	6.3	V_{ba} = 135 V	R_k = 360 Ω	R_i = 42 kΩ	W_a = 5 W	
Wide band	0.34	V_{bg2} = 165 V	I_a = 35 mA	μ_{g2g1} = 57	I_k = 50 mA	
pentode		V_{g3} = 0 V	I_{g2} = 5 mA	$R_{eq.}$ = 110 Ω	V_{kf} = 100 V	
		V_{bg1} = +12.5 V	S = 50 mA/V			
		Typical				
EC80	6.3	V_a = 250 V	I_a = 15 mA	μ = 80	W_a = 4 W	
U.H.F. triode	0.34	V_g = −1.5 V	S = 12 mA/V	f = < 500 MHz	I_k = 15 mA	
					V_{kf} = 100 V	

SPECIAL QUALITY TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical				
EC81 U.H.F. oscillator triode	6.3 0.175	$V_a = 150$ V $V_g = -2$ V	$I_a = 30$ mA $S = 5.5$ mA/V	$\mu = 16$ $f = < 750$ MHz	$W_a = 5$ W $I_k = 30$ mA $V_{kf} = 100$ V	
		Typical				
EC90 R.F. triode	6.3 0.15	$V_a = 250$ V $V_g = -8.5$ V	$I_a = 10.5$ mA $S = 2.2$ mA/V	$R_i = 7.7$ kΩ $\mu = 17$	$W_a = 3.5$ W $I_k = 30$ mA $V_{kf} = 150$ V	
		Operating				
		$f = 100$ MHz $V_a = 300$ V $V_g = -27$ V	$I_a = 17$ mA $+I_g = 2.9$ mA	$W_o = 3.3$ W $\eta = 55\%$		
		Typical				
EC91 U.H.F. triode	6.3 0.3	$V_a = 250$ V $V_g = -1.5$ V $I_a = 10$ mA	$S = 8.5$ mA/V $R_i = 12$ kΩ	$\mu = 100$ $R_{eq.} = 400\ \Omega$	$W_a = 2.5$ W $I_k = 15$ mA $V_{kf} = 150$ V	
		Typical				
EC1000 Triode measuring application	6.3 0.185	$V_a = 80$ V $V_g = -2$ V $I_a = 14$ mA	$S = 14.5$ mA/V $\mu = 27.5$	$-I_g = \leqslant 0.01\ \mu$A $f = 400$ MHz	$W_a = 1.5$ W $I_k = 22$ mA $V_{kf} = 55$ V	

		Typical				
EC8010 U.H.F. triode	6.3 0.28	$V_{ba}=200$ V $R_a=2.4$ kΩ	$R_k=47$ Ω $I_a=25$ mA	$S=28$ mA/V $\mu=60$	$W_a=4.5$ W $I_k=35$ mA $V_{kf}=100$ V	
		Typical				
ECC186 Double triode computer application	6.3 0.3 or 12.6 0.15	$V_a=250$ V $V_g=-8.5$ V $R_g=0.1$ MΩ	$I_a=10.5$ mA $S=2.2$ mA/V	$R_i=7.7$ kΩ $\mu=17$	$W_a=2.75$ W $I_k=20$ mA $V_{kf}=90$ V	
		Typical				
ECC2000 V.H.F. double triode	6.3 0.335	$V_a=90$ V $V_g=-1.4$ V	$I_a=27$ mA $S=22$ mA/V	$\mu=28$ $R_{eq.}=150$ Ω	$W_a=2.7$ W $I_k=40$ mA $V_{+k/-f}=150$ V	
		$V_{a'}=90$ V $V_{sn}=0$ V $V_{g'}=-1.4$ V	$I_a=27$ mA $S=17.5$ mA/V	$\mu=27$ $R_{eq.}=200$ Ω		
		Operating				
EF50 Wide band pentode	6.3 0.3	$V_a=250$ V $V_{g2}=250$ V $V_{g3}=0$ V $R_k=32$ Ω	$C_k=50$ pF $V_R=-1.55$ V $I_a=10$ mA	$I_{g2}=3$ mA $S=6.5$ mA/V $R_i=1$ MΩ	$W_a=3$ W $I_k=15$ mA $V_{kf}=100$ V	

SPECIAL QUALITY TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*				*Limiting values*	*Base connections*
		Operating					
EFF51 H.F. double pentode	6.3 0.75	V_a = 300 V V_{g2} = 225 V R_{g2} = 42 kΩ	V_{g1} = −2 V I_a = 10 mA I_{g2} = 1.8 mA	S = 9 mA/V R_i = 0.25 MΩ $R_{eq.}$ = 750 Ω		W_a = 3 W I_k = 15 mA V_{kf} = 50 V	
		Typical					
EFP60 Secondary emission pentode	6.3 0.37	V_a = 250 V V_{g2} = 250 V V_{g3} = 0 V V_{k3} = 150 V	V_{g1} = −2 V I_a = 20 mA I_{g2} = 1.5 mA I_{k3} = −15.6 mA	S = 25 mA/V R_i = 70 μ_{g2g1} = 110		W_a = 2 W W_{k3} = 1 W I_{k1} = 8 mA V_{k1f} = 50 V	
EL360 Output pentode	6.3 1.27	V_a = 250 V V_{g2} = 250 V	V_{g1} = −46 V I_a = 48 mA	I_{g2} = 5.5 mA S = 6.9 mA/V		W_a = 15 W I_k = 200 mA V_{kf} = 200 V	
		Typical					
12AX7S A.F. double triode	6.3 0.3 or 12.6 0.15	V_a = 250 V V_g = −2 V	I_a = 1.2 mA S = 1.6 mA/V	R_i = 62.5 kΩ μ = 100		W_a = 1.1 W I_k = 20 mA V_{kf} = 100 V	
		Typical					
5636 Dual control pentode	6.3 0.15	V_o = 100 V V_{g2} = 100 V V_{g3} = 0 V	R_k = 150 Ω I_a = 5.3 mA I_{g2} = 4 mA	S_{ag1} = 3.2 mA/V S_{ag3} = 0.5 mA/V R_i = 110 kΩ		W_a = 1.1 W I_k = 16 mA V_{kf} = 200 V	

Operating class A

5639	6.3	V_a = 150 V	I_a = 21 mA	R_i = 50 kΩ	W_a = 4 W	
Output	0.45	V_{g2} = 100 V	I_{g2} = 4 mA	$R_{a\sim}$ = 9 kΩ	I_k = 40 mA	
pentode		R_k = 100 Ω	S = 9 mA/V	W_o = 1 W	V_{kf} = 200 V	
5642	1.25				$V_{a\,invp}$ = 10 kV	
E.H.T.	0.2				I_a = 250 μA	
rectifier					I_{ap} = 1.5 mA	

Typical

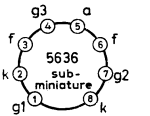
5654	6.3	V_a = 120 V	I_a = 7.5 mA	S = 5 mA/V	W_a = 1.65 W	
Wide band	0.175	V_{g2} = 120 V	I_{g2} = 2.5 mA	R_i = 0.34 MΩ	I_k = 20 mA	
pentode		V_{g1} = −2 V			V_{kf} = 135 V	

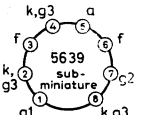
Operating class A

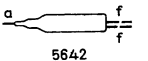
5672	1.25	V_a = 67.5 V	I_a = 3.1 mA	R_a = 20 kΩ	V_a = 90 V	
A.F. power	0.05	V_{g2} = 67.5 V	I_{g2} = 0.95 mA	W_o = 65 mW	V_{g2} = 90 V	
pentode		V_{g1} = −6.5 V	S = 0.65 mA/V	d_{tot} = 10 %	I_k = 5 mA	

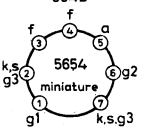
Typical

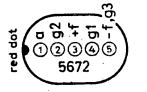
5678	1.25	V_a = 67.5 V	I_a = 1.8 mA	S = 1.1 mA/V	V_a = 90 V	
pentode	0.05	V_{g2} = 67.5 V	I_{g2} = 0.48 mA	R_i = 1 MΩ	V_{g2} = 67.5 V	
		V_{g1} = 0 V				

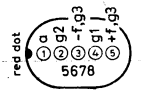




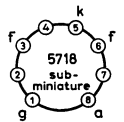
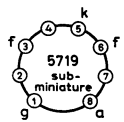
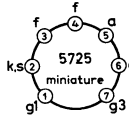
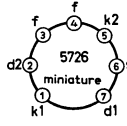


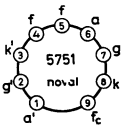
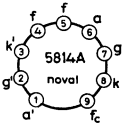
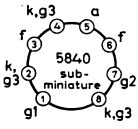
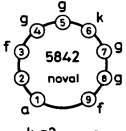
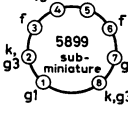




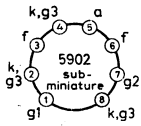
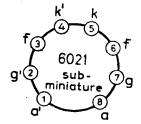
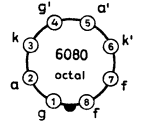
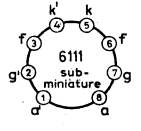


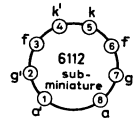
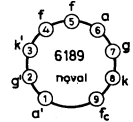
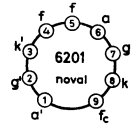
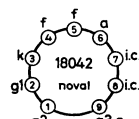
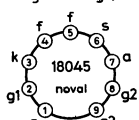
SPECIAL QUALITY TUBES

Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Typical				
5718 U.H.F. oscillator triode	6.3 0.15	$V_a = 100$ V $R_k = 150\ \Omega$ $I_a = 8.5$ mA	$S = 5.8$ mA/V $R_i = 4.7$ kΩ	$\mu = 27$ $f = < 1000$ MHz	$W_a = 3.3$ W $I_k = 22$ mA $V_{kf} = 200$ V	
		Typical				
5719 A.F. triode	6.3 0.15	$V_{ba} = 100$ V $R_k = 1.5$ kΩ	$I_a = 0.73$ mA $S = 1.7$ mA/V	$R_i = 41$ kΩ $\mu = 70$	$W_a = 0.55$ W $I_k = 3.3$ mA $V_{kfp} = 200$ V	
		Typical				
5725 Sharp cut-off pentode	6.3 0.175	$V_a = 120$ V $V_{g2} = 120$ V $V_{g3} = 0$ V	$V_{g1} = -2$ V $I_a = 5.2$ mA $I_{g2} = 3.5$ mA	$S_{g1} = 3.2$ mA/V $S_{g3} = 0.47$ mA/V $R_i = 150$ kΩ	$W_a = 1.85$ W $I_k = 20$ mA $V_{kf} = 100$ V	
		Operating				
5726 Double diode	6.3 0.3	$V_{tr} = 2 \times 165$ V_{rms} $C = 8\ \mu$F	$R_s = 300\ \Omega$	$I_o = \geqslant 16$ mA	$V_{invp} = 360$ V $I_{dp} = 60$ mA $V_{kfp} = 360$ V	

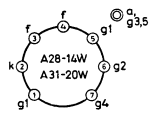
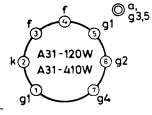
		Typical				
5751 A.F. double triode	6.3 0.35 or 12.6 0.175	V_{ba} = 250 V R_k = 3 kΩ V_{bg} = 0 V	I_a = 1 mA S = 1.2 mA/V	R_i = 58 kΩ μ = 70	W_a = 0.8 W V_{kf} = 100 V	
		Typical				
5814A Double triode	6.3 0.35 or 12.6 0.175	V_{ba} = 250 V R_k = 800 Ω V_{bg} = 0 V	I_a = 10.5 mA S = 2.2 mA/V	R_i = 7.7 kΩ μ = 17	W_a = 3 W I_k = 22 mA V_{kf} = 100 V	
		Typical				
5840 R.F. pentode	6.3 0.15	V_{ba} = 100 V V_{bg2} = 100 V R_k = 150 Ω	I_a = 7.5 mA I_{g2} = 2.4 mA	S = 5 mA/V R_i = 260 kΩ	W_a = 1.1 W I_k = 16.5 mA V_{kf} = 200 V	
		Typical				
5842 Wide band triode	6.3 0.3	V_a = 150 V R_k = 60 Ω	I_a = 26 mA S = 24 mA/V	R_i = 2.1 kΩ μ = 50	W_a = 4.5 W I_k = 38 mA V_{kf} = 60 V	
		Typical				
5899 Remote cut-off pentode	6.3 0.15	V_a = 100 V V_{g2} = 100 V R_k = 120 Ω	I_a = 7.2 mA I_{g2} = 2 mA	S = 4.5 mA/V R_i = 260 kΩ	W_a = 1.1 W I_k = 16.5 mA V_{kf} = 200 V	

SPECIAL QUALITY TUBES

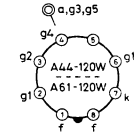
Type and application	V_f (V) I_f (A)	*Characteristic data*			*Limiting values*	*Base connections*
		Operating class A				
5902 Output pentode	6.3 0.45	V_{ba} = 109 V V_{bg2} = 109 V R_k = 270 Ω	I_a = 30 mA I_{g2} = 2.2 mA S = 4.2 mA/V	R_i = 15 kΩ $R_{a\sim}$ = 3 kΩ W_o = 1 W	W_a = 4 W I_k = 50 mA V_{kf} = 200 V	
		Typical				
6021 Double triode	6.3 0.3	V_a = 100 V R_k = 150 Ω	I_a = 6.5 mA S = 5.4 mA/V	R_i = 6.5 kΩ μ = 35	W_a = 0.7 W I_k = 22 mA V_{kf} = 200 V	
		Typical				
6080 Double triode Series regulator	6.3 2.5	V_a = 100 V R_k = 300 Ω	I_a = 100 mA S = 6.5 mA/V	R_i = 300 Ω μ = 2	W_a = 13 W I_k = 125 mA V_{kfp} = 300 V	
		Typical				
6111 Double triode	6.3 0.3	V_a = 100 V V_g = −1.9 V	I_a = 8.5 mA S = 5 mA/V	R_i = 4 kΩ μ = 20	W_a = 1.1 W I_k = 22 mA V_{kfp} = 200 V	

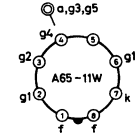
		Typical				
6112 Double triode	6.3 0.3	V_a = 100 V V_g = −1.2 V	I_a = 0.8 mA S = 1.8 mA/V	R_i = 38.8 kΩ μ = 70	W_a = 0.55 W I_k = 3.3 mA $V_{kf\,p}$ = 200 V	
		Typical				
6189 Double triode	6.3 0.3 or 12.6 0.15	V_a = 250 V V_g = −8.5 V I_a = 10.5 mA	S = 2.2 mA/V R_i = 7.7 kΩ	μ = 17 $-I_g$ = < 0.5 μA	W_a = 3 W I_k = 22 mA V_{kf} = 110 V	
		Typical				
6201 Double triode	6.3 0.3 or 12.6 0.15	V_a = 250 V R_k = 200 Ω I_a = 10 mA	S = 5.5 mA/V R_i = 10.9 kΩ	μ = 60 $-I_{g1}$ = < 0.7 μA	W_a = 2.8 W I_k = 18 mA V_{kf} = 100 V	
		Typical				
18042 pentode	18 0.1	V_a = 210 V V_{g2} = 120 V V_{g3} = 0 V R_k = 165 Ω	I_a = 10 mA I_{g2} = 2.1 mA S = 9 mA/V	R_i = 0.5 MΩ μ_{g2g1} = 38 $R_{eq.}$ = 750 Ω	W_a = 2.1 W I_k = 16 mA V_{kf} = 100 V	
		Operating class A				
18045 Output pentode	18 0.13	V_a = 210 V V_{g2} = 210 V V_{g3} = 0 V R_k = 120 Ω I_a = 20 mA	I_{g2} = 5.3 mA S = 11 mA/V R_i = 0.3 MΩ μ_{g2g1} = 36	$R_{eq.}$ = 1.2 kΩ $R_{a\sim}$ = 15 kΩ W_o = 1 W d_{tot} = 5%	W_a = 4.5 W I_k = 30 mA V_{kf} = 120 V	

CATHODE-RAY TUBES — T.V. Picture tubes

Type *Deflection angle* *Transmission*	V_f (V) I_f (A)	*Typical operating characteristics*	*Min. useful screen* *diag.*	*width*	*height*	*Max. overall length*	*Base connections*
A28-14W[1]) 90° 50%	11 0.075	$V_{a,g3,g5}$ = 11 kV V_{g4} = 0–350 V[2]) V_{g2} = 250 V $-V_{GR}$ = 35–69 V V_{GK} = 32–58 V	263	228	171	250	
A31-20W[1]) 90° 54%			295	257	195	277	
A31-120W[1]) 110° 50%	11 0.075	$V_{a,g3,g5}$ = 12 kV V_{g4} = 0–350 V[2]) V_{g2} = 250 V $-V_{GR}$ = 35–69 V V_{GK} = 32–58 V	295	257	195	233	
A31-410W[1]) 110° 50%	11 0.14		295	257	195	233	

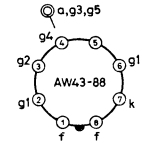
A44-120W[1]) 110° 48%			413	346	270	291
A47-14W 110° 48%			446	384	305	309
A47-26W[1]) 110° 48%			446	384	305	309
A50-120W[1]) 110° 45%			473	394	308	319
A59-11W[1]) 110° 45%	6.3 0.3	$V_{a,g3,g5}$ = 20 kV V_{g4} = 0–400 V[2]) V_{g2} = 400 V $-V_{GR}$ = 40–77 V V_{KR} = 36–66 V	566	489	385	367
A59-15W 110° 45%			566	489	385	367
A59-16W[1]) 110° 45%			567	491	388	375
A59-23W[1]) 110° 45%			566	489	385	367
A61-120W[1]) 110° 42%			578	481	375	370
A65-11W[1]) 110° 43%	6.3 0.3	$V_{a,g3,g5}$ = 20 kV V_{g4} = 0–400 V[2]) V_{g2} = 500 V $-V_{g1}$ = 50–93 V V_k = 45–80 V	617	530	416	391

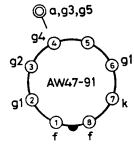
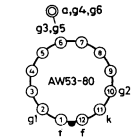
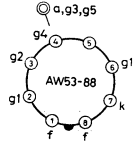
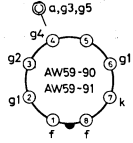




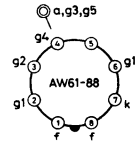
[1]) Tube can be used without safety panel. [2]) Voltage range to obtain optimum overall focus at 100 μA beam current.

CATHODE-RAY TUBES - T.V. Picture tubes

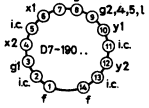
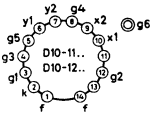
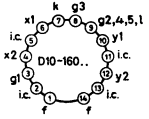
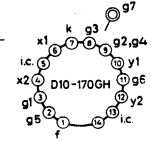
Type *Deflection angle* *Transmission*	V_f (V) I_f (A)	*Typical operating characteristics*	*Min. useful screen* *diag.*	*width*	*height*	*Max. overall length*	*Base connections*
A56-120X [1] 90° 54,5%	**Colour tubes**		533	447	337	482	
A56-140X 110° 54,5%			533	447	337	400	
A63-11X [1] 90° 52,5%	6.3 0.9	$V_{a,g4,g5}$ = 25 kV V_{g3} = 4.2–5.0 kV V_{g2} = 210–495 V $-V_{GR}$ = 70–140 V	584	504	396	531	
A63-120X [1] 90° 52.5%			584	504	396	531	
A66-120X [1] 90° 52.5%			617.8	518	390	528	
A66-140X [1] 110° 52,5%			617.8	518	390	438	
AW43-88 110° 75%	6.3 0.3	$V_{a,g3,g5}$ = 16 kV V_{g2} = 300 V V_{g4} = 0–400 V [2] $-V_{GR}$ = 30–72 V V_{KR} = 28–60 V	400	374.5	295	326	

AW47-91 110° 75%	6.3 0.3	$V_{a,g3,g5}$ = 20 kV V_{g4} = 0–400 V [2]) V_{g2} = 400 V $-V_{GR}$ = 40–77 V V_{KR} = 36–66 V	446	384	305	309	
AW53-80Z 90° 70%	6.3 0.3	$V_{a,g4,g6}$ = 16 kV $V_{g3,g5}$ = −75 to 235 V [2]) V_{g2} = 300 V $-V_{GR}$ = 40–80 V	511	482	378	492	
AW53-88 110° 75%	6.3 0.3	$V_{a,g3,g5}$ = 16 kV V_{g4} = 0–400 V [2]) V_{g2} = 300 V $-V_{GR}$ = 30–72 V V_{KR} = 28–60 V	514.5	484	382.5	381	
AW59-90 110° 75%	6.3 0.3	$V_{a,g3,g5}$ = 18 kV V_{g4} = 0–400 V [2]) V_{g2} = 300 V $-V_{GR}$ = 30–72 V V_{KR} = 28–60 V	566	489	385	386	
AW59-91 110° 75%	6.3 0.3	$V_{a,g3,g5}$ = 18 kV V_{g4} = 0–400 V [2]) V_{g2} = 400 V $-V_{GR}$ = 40–77 V V_{KR} = 36–66 V	566	489	385	366	

[1]) Tube can be used without safety panel. [2]) Voltage range to obtain optimum overall focus at 100 μA beam current.

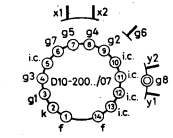
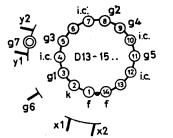
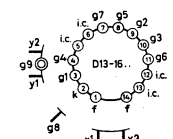
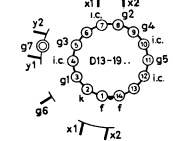
Type *Deflection angle* *Transmission*	V_f (V) I_f (A)	*Typical operating characteristics*	*Min. useful screen* *diag.*	*width*	*height*	*Max. overall* *length*	*Base connections*
AW61-88 110° 75%	6.3 0.3	$V_{a,g3,g5} = 16$ kV $V_{g2} = 300$ V $V_{g4} = 0$–400 V [1] $-V_{GR} = 30$–72 V $V_{KR} = 28$–60 V	579.5	544.5	428.5	411	

[1]) Volt. range to obtain optimum overall focus at 100 μA beam current.

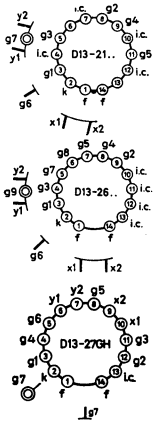
Type	V_f (V) I_f (A)	Typical operating conditions		Display area Deflection factor hor. vert.	Max. overall length	Base connections
D7-190GH **D7-190GM** **D7-190GP**	6.3 0.3	$V_{g2,g4,g5(1)}$ = 1 kV V_{g3} = 100–180 V	$-V_{g1}$ = < 35 V [1]	6 cm × 5 cm M_x = M_y = 29 V/cm 11.5 V/cm	225	
D10-11GH **D10-11GM** **D10-11GP**	6.3 0.095					
D10-12GH **D10-12GM** **D10-12GP**	6.3 0.3	$V_{g6(1)}$ = 4 kV V_{g5} = 1 kV V_{g4} = 1 kV	V_{g3} = 50–200 V V_{g2} = 1 kV $-V_{g1}$ = 25–67 V [1]	full scan × 6 cm M_x = M_y = 27.5 V/cm 9.8 V/cm	320	
D10-160GH **D10-160GM** **D10-160GP**	6.3 0.3	$V_{g2,g4,g5(1)}$ = 1.5 kV V_{g3} = 140–275 V	$-V_{g1}$ = < 50 V [1]	8 cm × 6 cm M_x = M_y = 32 V/cm 13.7 V/cm	260	
D10-161..	6.3 0.095	For further data see D10-160..				
D10-170GH	6.3 0.3	$V_{g7(1)}$ = 6 kV V_{g6} = 1 kV V_{g5} = 1 kV	V_{g3} = 170–230 V $V_{g2,g4}$ = 1 kV $-V_{g1}$ = 16–40 V [1]	8 cm × 6 cm M_x = M_y = 13 V/cm 3.5 V/cm	335	

[1]) Grid voltage for visual cut-off.

CATHODE-RAY TUBES - Instrument tubes

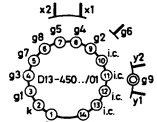
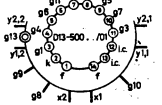
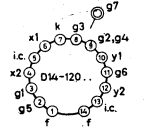
Type	V_f (V) I_f (A)	Typical operating conditions		Display area Deflection factor hor. vert.	Max. overall length	Base connections
D10-200GH/07	6.3 0.3	$V_{g8(l)}$ = 15 kV V_{g7} = 1.5 kV V_{g6} = 1.5 kV V_{g5} = 1.5 kV	V_{g4} = 1.5 kV V_{g3} = 380–520 V V_{g2} = 1.5 kV $-V_{g1}$ = 40–100 V	8 cm × 5 cm M_x = M_y = 12 V/cm 3.5 V/cm	383	
D13-15GH **D13-15GM** **D13-15GP**	6.3 0.3	$V_{g7(l)}$ = 4 kV V_{g6} = 2 kV V_{g5} = 2 kV V_{g4} = 2 kV	V_{g3} = 220–710 V V_{g2} = 2 kV $-V_{g1}$ = 60–96 V [1]	10 cm × 6 cm M_x = M_y = 23 V/cm 5.9 V/cm	468	
D13-16GH **D13-16GP**	6.3 0.3	$V_{g9(l)}$ = 10 kV V_{g8} = 1.67 kV V_{g7} = 1.67 kV V_{g6} = 1.67 kV V_{g5} = 1.67 kV	V_{g4} = 230–500 V V_{g3} = 1.67 kV V_{g2} = 1.67 kV $-V_{g1}$ = 50–120 V [1]	10 cm × 6 cm M_x = M_y = <18 V/cm 6 V/cm	600	
D13-16../01	Equivalent to D13-16 . . but for internal graticule					
D13-19GH **D13-19GM** **D13-19GP**	6.3 0.3	$V_{g7(l)}$ = 10 kV V_{g6} = 1.67 kV V_{g5} = 1.67 kV V_{g4} = 1.67 kV	V_{g3} = 320–500 V V_{g2} = 1.67 kV $-V_{g1}$ = 53–82 V [1]	10 cm × 6 cm M_x = M_y = 30 V/cm 10.9 V/cm	452	

D13-21GH **D13-21GM** **D13-21GP**	6.3 0.3	$V_{g7(I)}$ = 10 kV V_{g6} = 1.67 kV V_{g5} = 1.67 kV V_{g4} = 1.67 kV	V_{g3} = 320–500 V V_{g2} = 1.67 kV $-V_{g1}$ = 50–80 V [1])	10 cm × M_x = 30 V/cm	4 cm M_y = 6.4 V/cm	468
D13-26GH **D13-26GP**	6.3 0.3	$V_{g9(I)}$ = 15 kV $-V_{g8}$ = 12–18 V V_{g7} = 1.5 kV V_{g6} = 1.5 kV V_{g5} = 1.5 kV	V_{g4} = 1.5 kV V_{g3} = 375–625 V V_{g2} = 1.5 kV $-V_{g1}$ = 40–90 V [1])	10 cm × M_x = 9.5 V/cm	6 cm M_y = 2.9 V/cm	450
D13-26 . . /01		Equivalent to D13-26 . . but for internal graticule				
D13-27GH	6.3 0.3	$V_{g7(I)}$ = 3 kV V_{g6} = 1.5 kV V_{g5} = 1.5 kV V_{g4} = 300–550 V	V_{g3} = 1.5 kV V_{g2} = 1.5 kV $-V_{g1}$ = 38–135 V [1])	full scan × M_x = 24 V/cm	8 cm M_y = 11.5 V/cm	350

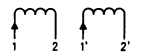


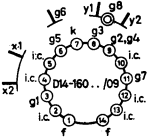
[1]) Grid voltage for visual cut-off.

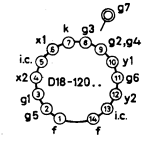
CATHODE-RAY TUBES - Instrument tubes

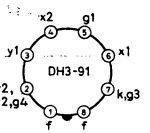
Type	V_f (V) I_f (A)	Typical operating conditions		Display area Deflection factor hor. vert.	Max. overall length	Base connections
D13-450GH/01	6.3 0.3	$V_{g9(t)} = 15$ kV $-V_{g8/g7} = 12$–18 V $V_{g7} = 1.5$ kV $V_{g6} = 1.5$ kV $V_{g5} = 1.5$ kV	$V_{g4} = 1.5$ kV $V_{g3} = 400$–550 V $V_{g2} = 1.5$ kV $-V_{g1} = 40$–100 V [1]	10 cm × 6 cm $M_x =$ $M_y =$ 9.9 V/cm 3 V/cm	459	
D13-480GH **D13-480GM** **D13-480GP**	6.3 0.3	$V_{g2,g4,g5(t)} = 2$ kV $V_{g3} = 220$–370 V	$-V_{g1} = 65$ V [1]	10 cm × 8 cm $M_x =$ $M_y =$ 31.3 V/cm 14.4 V/cm	310	
D13-481..	6.3 0.095	For further data see D13-480..				
D13-500GH/01	6.3 0.3	$V_{g13(t)} = 15$ kV $-V_{g12-g11} = 9$–15 V $V_{g11} = 2.5$ kV $V_{g10} = 2.5$ kV $-V_{g9-g2} = 250$–375 V $V_{g8-g2} = 200$ V $V_{g7} = 2.5$ kV	$-V_{g6-g2} = 500$–700 V $V_{g5} = 2,5$ kV $-V_{g4-g2} = 700$–900 V $V_{g3} = 2,5$ kV $V_{g2} = 2,5$ kV $-V_{g1} = 75$–150 V [1]	10 cm ± 6 cm $M_x =$ $M_y =$ 13,5 V/cm 1,7 V/cm	493	
D14-120GH **D14-120GM** **D14-120GP**	6.3 0.3	$V_{g7(t)} = 10$ kV $V_{g6} = 1.5$ kV $V_{g5} = 1.5$ kV	$V_{g3} = 250$–350 V $V_{g2,g4} = 1.5$ kV $-V_{g1} = 20$–60 V [1]	10 cm × 8 cm $M_x =$ $M_y =$ 15.5 V/cm 4.2 V/cm	385	

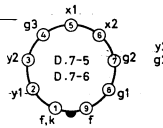
D14-121GH **D14-121GM** **D14-121GP**	6.3 0.3	$V_{g8(l)}$ = 10 kV V_{g7} = 1.5 kV V_{g6} = 1.5 kV V_{g5} = 1.5 kV	V_{g3} = 250–350 V $V_{g2,g4}$ = 1.5 kV $-V_{g1}$ = 20–60 V [1]	10 cm × 8 cm M_x = M_y = 15.5 V/cm 4.2 V/cm		385
D14-122..		This type is equivalent with type D14-120 . . , but provided with a rotation coil.				
D14-123..		This type is equivalent with type D14-121 . . , but provided with a rotation coil.				
D14-160GH/09 **D14-160GM/09**	6.3 0.3	$V_{g8(l)}$ = 10 kV V_{g7} = 1.5 kV V_{g6} = 1.5 kV V_{g5} = 1.5 kV	V_{g3} = 450–550 V V_{g2+4} = 1,5 kV $-V_{g1}$ = 30–70 V [1]	10 cm ± 8 cm M_x = M_y = 15,2 V/cm 4,1 V/cm		418
D18-120GH	6,3 0,3	$V_{g7(l)}$ = 10 kV V_{g6} = 2 kV V_{g5} = 2 kV	V_{g3} = 350–450 V V_{g2+4} = 2 kV $-V_{g1}$ = 25 to 80 V [1]	12 cm ± 10 cm M_x = M_y = 16 V/cm 5 V/cm		454
DH3-91	6.3 0.3	$V_{g4,g2,y2(l)}$ = 500 V	$-V_{g1}$ = 8–27 V [1]	full scan × full scan M_x = M_y = 56.5 V/cm 49 V/cm		105
DG7-5 **DP7-5**						
DG7-6 [2] **DP7-6**	6.3 0.3	$V_{g3(l)}$ = 800 V V_{g2} = 200–300 V	$-V_{g1}$ = < 50 V [1]	full scan × full scan M_x = M_y = 62.5 V/cm 40 V/cm		160





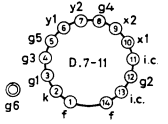
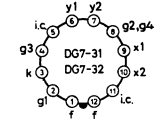
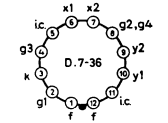
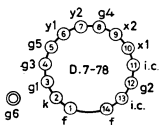




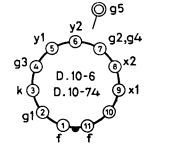


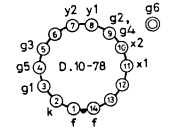
[1]) Grid voltage for visual cut-off. [2]) X plates asymmetrical.

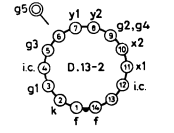
CATHODE-RAY TUBES - Instrument tubes

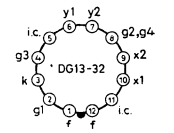
Type	V_f (V) I_f (A)	Typical operating conditions		Display area Deflection factor hor. vert.	Max. overall length	Base connections
DH7-11 **DN7-11** **DP7-11**	6.3 0.095	$V_{g6(t)}$ = 1.2 kV V_{g5} = 300 V V_{g4} = 300 V	V_{g3} = 20–150 V V_{g2} = 1.2 kV $-V_{g1}$ = 30–80 V [1]	6 cm × 4.5 cm M_x = M_y = 10.7 V/cm 3.7 V/cm	296	
DG7-31 [2] **DG7-32**	6.3 0.3	$V_{g4,g2(t)}$ = 500 V V_{g3} = 0–120 V	$-V_{g1}$ = 50–100 V [1]	full scan × full scan M_x = M_y = 37 V/cm 21 V/cm	172	
DG7-36 **DN7-36**	6.3 0.3	$V_{g4,g2(t)}$ = 1.5 kV V_{g3} = 247–397 V	$-V_{g1}$ = 40–80 V [1]	6.8 cm × 5.7 cm M_x = M_y = 27.3 V/cm 18.8 V/cm	296	
DH7-78 **DN7-78** **DP7-78**	6.3 0.3	$V_{g6(t)}$ = 1.2 V_{g5} = 300 V_{g4} = 300 V_{g3} = 20–150 V_{g2} = 1.2 $-V_{g1}$ = 36–72	4.0 kV 1000 V 1000 V 35–165 V 1.0 kV 30–60 V [1]	6 cm × 4.5 cm M_x = M_y = 10.7 V/cm 3.7 V/cm at $V_{g6(t)}$ = 1.2 kV 35.6 V/cm 12.2 V/cm at $V_{g6(t)}$ = 4 kV	296	

DG10-6 **DP10-6**	6.3 0.3	$V_{g5(l)} = 4$ kV $V_{g4,g2} = 2$ kV	$V_{g3} = 400$–720 V $-V_{g1} = 45$–100 V [1]	full scan × $M_x =$ 46 V/cm	full scan $M_y =$ 36 V/cm	341
DG10-74 **DP10-74**	6.3 0.3	$V_{g5(l)} = 4$ kV $V_{g4,g2} = 2$ kV	$V_{g3} = 400$–720 V $-V_{g1} = 45$–100 V [1]	full scan × $M_x =$ 46 V/cm	full scan $M_y =$ 36 V/cm	341
DH10-78 **DN10-78** **DP10-78**	6.3 0.3	$V_{g6(l)} = 4$ kV $V_{g5} = 1$ kV $V_{g4,g2} = 1$ kV	$V_{g3} = 150$–350 V $-V_{g1} = 22$–38 V [1]	7.5 cm × $M_x =$ 34 V/cm	5.5 cm $M_y =$ 11 V/cm	305
DG13-2 **DP13-2**	6.3 0.3	$V_{g5(l)} = 4$ kV $V_{g4,g2} = 2$ kV	$V_{g3} = 400$–720 V $-V_{g1} = 45$–100 V [1]	full scan × $M_x =$ 31 V/cm	full scan $M_y =$ 27 V/cm	435
DG13-32	6.3 0.6	$V_{g4,g2(l)} = 2$ kV $V_{g3} = 340$–640 V	$-V_{g1} = \leqslant 90$ V [1]	full scan × $M_x =$ 26 V/cm	full scan $M_y =$ 21 V/cm	385



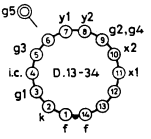
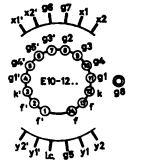
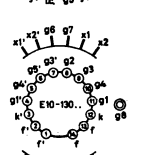






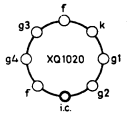
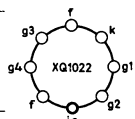
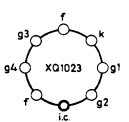
[1]) Grid voltage for visual cut-off. [2]) X plates asymmetrical

CATHODE-RAY TUBES - Instrument tubes

Type	V_f (V) I_f (A)	Typical operating conditions		Display area Deflection factor hor. vert.	Max. overall length	Base connections
DG13-34 **DP13-34**	6.3 0.6	$V_{g5(1)} = 4$ kV $V_{g4,g2} = 2$ kV	$V_{g3} = 400$–690 V $-V_{g1} = 45$–75 V [1]	10.2 cm × 10.2 cm $M_x =$ 23.7 V/cm 17.7 V/cm	430	
E10-12GH **E10-12GM** **E10-12GP**	6.3 0.3	$V_{g8(1)} = 3$ kV $V_{g7} = 1$ kV $V_{g6} = 1$ kV $V_{g5} = 1$ kV	$V_{g4} = 180$–380 V $V_{g3} = 1$ kV $V_{g2} = 1$ kV $-V_{g1} = 25$–90 V [1]	full scan × 7 cm $M_x =$ $M_y =$ 15 V/cm 7 V/cm	410	
E10-130GH **E10-130GM** **E10-130GP**	6.3 0.3	$V_{g8(1)} = 4$ kV $V_{g7} = 1$ kV $V_{g6} = 1$ kV $V_{g5} = 1$ kV	$V_{g4} = 200$–320 V $V_{g3} = 1$ kV $V_{g2} = 1$ kV $-V_{g1} = 25$–90 V [1]	full scan × 7 cm $M_x =$ $M_y =$ 17 V/cm 7.4 V/cm	410	
E14-100GH	6.3 0,3	$V_{g7(1)} = 10$ kV $V_{g6} = 1{,}5$ kV $V_{g5} = 1{,}5$ kV	$V_{g3} = 350$ to 650 V $V_{g2+4} = 1{,}5$ kV $-V_{g1} = 20$ to 70 V [1]	10 cm × 8 cm $M_x =$ $M_y =$ 13,5 V/cm 9 V/cm	425	

[1]) Grid voltage for visual cut-off.

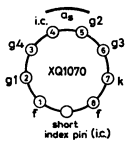
CATHODE-RAY TUBES — Camera tubes "Plumbicons"

Type *Resolution*	V_f (V) I_f (A)	*Applications*		*Dimensions* *diam.*	*length*	*Base* *connections*
XQ1020 ⩾600 lines	6.3 0.3	For use in black and white broadcast cameras	Focusing: magn. Deflection: magn. >325 μA/lm	30.6	220	
XQ1020L			>325 μA/lm			
XQ1020R		For use in colour	> 70 μA/lm			
XQ1020G		broadcast cameras	>130 μA/lm			
XQ1020B			> 35 μA/lm			
XQ1021		For industrial black and white cameras				
XQ1021R **XQ1021G** **XQ1021B**		For use in industrial colour cameras		For all further informations see data of the XQ1020 series		
XQ1022	6.3 0.3	For use with X-ray image intensifiers in medical equipment	Focusing: magn. Deflection: magn. P20 light distribution >200 μA/lm	30.6	214	
XQ1023[1] ⩾700 lines	6.3 0.3	For use in black and white cameras	Focusing: magn. Deflection: magn. 450 μA/lmF	30.6	220	
XQ1023L		For use in the luminance channel of four tube colour cameras	450 μA/lmF			
XQ1023R		For use in the red channel of both three and four tube colour cameras	160 μA/lmF			

[1]) With extended red response.

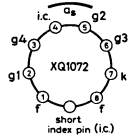
CATHODE-RAY TUBES - Camera tubes "Plumbicons"

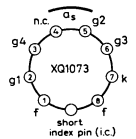
Type resolution	V_f (V) I_f (A)	Applications		Dimensions diam.	 length	Base connections
XQ1024[1]		For industrial black and white cameras		For all further information see data of the XQ1023 series		
XQ1024R[1]		For use in the red channel of industrial colour cameras				
XQ1025[1] **XQ1025L** **XQ1025R**		The tubes of the XQ1025 series are identical to the tubes of the XQ1023 series but incorporate an infra-red reflecting filter on the anti-halation glass disc. For all further information see data of the XQ1023 series				
XQ1026[1]		For industrial black and white cameras		For all further information see data of the XQ1025 series		
XQ1026R[1]		For use in the red channel of industrial colour cameras				
XQ1070 **XQ1070/01** ⩾ 750 lines	6.3 0.095	For use in black and white cameras	Focusing: magn. Deflection: magn. > 325 μA/lm	25.4	158	
XQ1070L-XQ1070/01L **XQ1070R-XQ1070/01R** **XQ1070G-XQ1070/01G** **XQ1070B-XQ1070/01B**		For use in colour cameras in broadcast, educational and high quality industrial applications	> 325 μA/lm > 70 μA/lm > 130 μA/lm > 35 μA/lm			



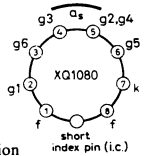
[1]) With extended red response.

XQ1071 **XQ1071/01** ⩾600 lines	6.3 0.095	For use in industrial black and white cameras		For all further information see data of the XQ1070/XQ1070/01 series	
XQ1071R-XQ1071/01R **XQ1071G-XQ1071/01G** **XQ1071B-XQ1071/01B**		For use in the chrominance channels of colour cameras			
XQ1072 ⩾600 lines	6.3 0.095	For use with X-ray intensifier in medical equipment	Focusing: magn. Deflection: magn. P20 light distribution > 200 μA/lm	25.4	158
XQ1073 **XQ1073/01** ⩾750 lines	6,3 0,095	For use in black and white cameras	Focusing: magn. Deflection: magn. > 310 μA/lm	25.4	158
XQ1073R-XQ1073/01R		For use in the red channel of colour cameras in broadcast	> 75 μA/lm		
XQ1074 **XQ1074/01**		For industrial black and white cameras		For all further information see date of the XQ1073/XQ1073/01 series	
XQ1074R-XQ1074/01R		For use in the red channel of colour cameras			
XQ1075 **XQ1075R**		The tubes of the XQ1075 series are identical to the tubes of the XQ1073 series but incorporate an infra-red reflecting filter on the anti-halation glass disc			
XQ1076 **XQ1076R**		For industrial black and white cameras For use in the red channel of colour cameras		For all further information see data of XQ1073 and XQ1075	

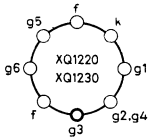


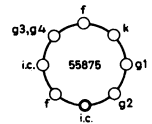


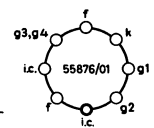
CATHODE-RAY TUBES - Camera tubes "Plumbicons"

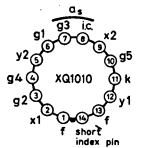
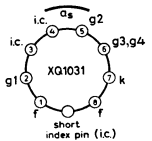
Type *resolution*	V_f (V) I_f (A)	*Applications*		*Dimensions* *diam.*	*length*	*Base* *connections*
XQ1080 ⩾ 750 lines **XQ1080L** **XQ1080R** **XQ1080G** **XQ1080B**	6,3 0.095	For use in black and white cameras For use in colour cameras in broadcast, educational and high quality industrial application	> 325 μA/lm > 325 μA/lm > 70 μA/lm > 130 μA/lm > 35 μA/lm	25.4	158	
XQ1081 series		For use in industrial black and white and colour cameras		For all further information see data of the XQ1080 series		
XQ1090		As XQ1080 but front loader type				
XQ1091		As XQ1081 but front loader type				
XQ1100		As XQ1090 but without anti-halation glass disc				
XQ1101		As XQ1091 but without anti-halation glass disc				
XQ1102		As XQ1100 but intended for use with X-ray image intensifier in medical equipment				

XQ1220 series **XQ1230** series	6.3 0.3	For use in medical scientific and low light level T.V. systems in which they can be coupled direct to e.g., X-ray image intensifiers and light intensifiers with fibre optic output windows. Provided with lightpipe and A.C.T. electron gun	Focusing: magn. Deflection: magn.	30	210
55875 ⩾600 lines	6.3 0.090	For use in black and white broadcast cameras	Focusing: magn. Deflection: magn. >325 μA/lm	30.6	220
55875L			>325 μA/lm		
55875R		For use in colour broadcast cameras	> 70 μA/lm		
55875G			>130 μA/lm		
55875B			> 35 μA/lm		
55875-IG		For black and white industrial cameras			
55875R-IG **55875G-IG** **55875B-IG**		For use in the chrominance channels of industrial colour cameras		For all further informations see data of the 55875 series	
55876/01 ⩾600 lines	6.3 0.090	For use with X-ray image intensifier in medical equipment	Focusing: magn. Deflection: magn. P20 light distribution >200 μA/lm	30.6	214

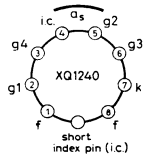
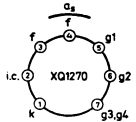
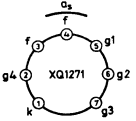
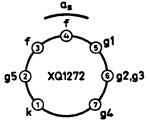


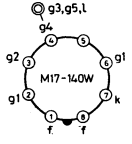
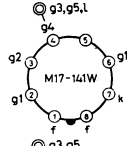
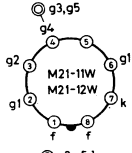
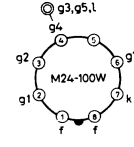




Type *resolution*	V_f (V) I_f (A)	*Applications*		*Dimensions* *diam.*	 *length*	*Base* *connections*
XQ1010 ⩾600 lines	6.3 0.3	For use in compact T.V. systems in industrial and other applications	Focusing: electrostatic Deflection: electrostatic	25.5	159	
XQ1031 ⩾600 lines	6,3 0,095	For use in industrial and broadcast applications in which a high standard of performance is required	Focusing: magn. Deflection: magn.	25,5	130	
XQ1032		General purpose tube for less critical industrial applications, experiments, amateur use etc.		For all other data see XQ1031		

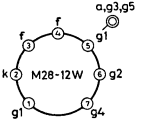
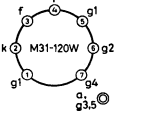
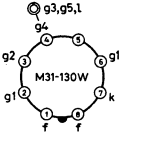
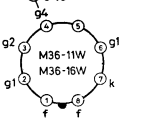
CATHODE-RAY TUBES - Camera tubes "Vidicons"

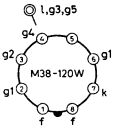
Type *resolution*	V_f (V) I_f (A)	*Applications*		*Dimensions* *diam.*	*length*	*Base* *connections*
XQ1240 ⩾ 1000 lines	6,3 0,095	For use in industrial, medical and broadcast applications in which a high standard of performance is required	Focusing: magn. Deflection: magn.	25.5	158	
XQ1241		General purpose tube for less critical industrial applications, experiments, amateur use etc.		For all other data see XQ1240		
XQ1270 (20 PE11) ⩾ 400 lines	6,3 0,1	For use in ultra compact T.V. cameras for industrial and consumer applications (integral mesh construction)	Focusing: magn. Deflection: magn.	17,7	108	
XQ1271 (20 PE13)		Separate mesh construction		For all other data see XQ1270		
XQ1272 (20 PE14)		Separate mesh construction	Focusing: electrostatic	For all other data see XQ1270		

Type Deflection angle Resolution (min)	V_f (V) I_f (A)	Typical operating characteristics	Min. useful screen (mm) diag.	 width	 height	Max. overall length	Base connections
M17-140W 70° 1000 lines	6.3 0.3	$V_{g3,g5(1)} = 14$ kV $V_{g4} = 0$–400 V $V_{g2} = 400$ V $-V_{g1}$ [1]) = 30–62 V	155	124	93	234	
M17-141W 70° 1100 lines	6.3 0.3	$V_{g3,g5(1)} = 16$ kV $V_{g4} = 0$–400 V $V_{g2} = 600$ V $-V_{g1}$ [1]) = 40–90 V	155	124	93	240	
M21-11W 90° 650 lines	11 0.075	$V_{g3,g5(1)} = 12$ kV $V_{g4} = 0$–400 V $V_{g2} = 400$ V $-V_{g1}$ [1]) = 32–69 V V_k [2]) = 29–62 V	195	180	135	222	
M21-12W 110° 625 lines	6.3 0.3	$V_{g3,g5(1)} = 16$ kV $V_{g4} = 0$–400 V $V_{g2} = 300$ V $-V_{g1}$ [1]) = 35–72 V	200	190.5	149.2	205	
M24-100W[1]) **M24-101W** 90° 900 lines	6,3 0.3	$V_{g3,g5(1)} = 16$ kV $V_{g4} = 0$–400 V $V_{g2} = 600$ V $-V_{g1}$ [1]) = 32–85 V	225	190	140	260	

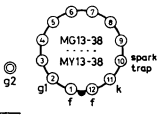
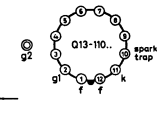
[1]) Execution with integral protection band

CATHODE-RAY TUBES — Monitor tubes

Type *Deflection angle* *Resolution (min)*	V_f (V) I_f (A)	*Typical operating characteristics*	*Min. useful screen (mm)* *diag.*	*width*	*height*	*Max. overall length*	*Base connections*
M28-12W 90° 850 lines	11 0.075	$V_{a,g3,g5} = 13$ kV $V_{g4} = 50$–400 V $V_{g2} = 350$ V $-V_{g1}$ [1] $= 46$–91 V V_k [2] $= 44$–80 V	262.5	228	171	250	
M31-120W 110° 850 lines	11 0.075	$V_{a,g3,g5} = 11$ kV $V_{g4} = 0$–350 V $V_{g2} = 250$ V $-V_{g1}$ [1] $= 35$–69 V V_k [2] $= 32$–58 V	295	257	195	233	
M31-130W	6,3 0,3	$V_{g3,g5(l)} = 16$ kV $V_{g4} = 0$–400 V $V_{g2} = 600$ V $-V_{g1} = 32$–85 V [1]	295	257	195	310	
M36-11W **M36-16W** [3] 90° 650 lines	11 0.075	$V_{g3,g5(l)} = 16$ kV $V_{g4} = 0$–500 V $V_{g2} = 600$ V $-V_{g1}$ [1] $= 43$–98 V V_k [2] $= 40$–90 V	329	304.5	241	317	

M38-120W **M38-121W**[2]) 110° 650 lines	6.3 0.3	$V_{a,g3,g5} = 16$ kV $V_{g4} = 0$–400 V $V_{g2} = 400$ V V_{g1} [1]) $= 40$–85 V	350	291	226	280	

CATHODE-RAY TUBES — Flying spot scanners and Projection tubes

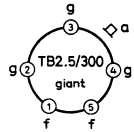
Type *Deflection angle* *Resolution (min)*	V_f (V) I_f (A)	*Typical operating characteristics*	*Min. useful screen (mm)* *diag.*	*width*	*height*	*Max. overall length*	*Base connections*
MC13-16 **MK13-16**		Apart for the phosphor the Q13-110 . . is equivalent to the M. 13-16					
MG13-38 **MU13-38** **MW13-38** **MY13-38** 47°	6.3 0.3	$V_{g2(t)} = 50$ kV $-V_{g1}$ [1]) $= 100$–170 V $I_{g2p} =$ min. 2.5 mA	Useful diam. min. 69 × 92 mm²			374	
Q13-110BA **Q13-110GU** 40° 1000 lines	6.3 0.3	$V_{g2(t)} = 25$ kV $I_t = 50$–150 μA $-V_{g1}(I_t = 0) = 50$–100 V	Useful screen diam. min. 108 mm			347	

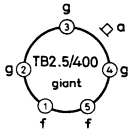
[1]) Grid voltage for visual cut-off. [2]) Cathode voltage for visual cut-off. [3]) Execution with integral protection band

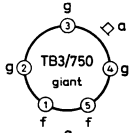
TRANSMITTING TUBES — TRIODES

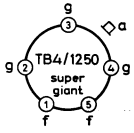
Type and application	V_f (V) I_f (A)	*Operating conditions*	f (MHz)	V_a (kV)	I_a (A)	W_o (kW)	*Limiting values* V_a (kV)	W_a (kW)	*Accessories*	*Base connections* *Max. dimensions* *diam.*	*length*
TAL12/10	22	C telegr.	5	12	1.21	10.5	12	4	Fil. conn.: 40604	194	471
R.F. power triode	38[1])	C telegr.	20	10	1.45	10.5	12	4	Ins. pedestal: K501 Supp. ring: 40603 Protect. cap. for grid seals: 40632		
TAL12/20	21.5	C telegr.	28	12	2.7	22	12	18	Fil. conn.: 40662	125	567
R.F. power triode	78	C an. mod.	28	10	1.4	9.5	12	18	Grid. conn.: 40664 Cooling house: K503/01		
TAL12/35	28.3	C telegr.	20	15	4.2	48.5	15	18	Fil. conn.: 40606	226	630
Air cooled R.F. power triode	48.5[1])	C telegr.	37.5	10	4.2	26	15	18	Protect. cap for seals: 40632 Cooling house: K505		
TAW12/10	22	C telegr.	5	12	1.7	15	12	7.5	Fil. conn.: 40604	194	440
R.F. power triode	38[1])	C telegr.	75	4	1.7	3.5	12	7.5	Water jacket: K700 Prot. cap for grid seals: 40632		

TAW12/20	For further data see TAL12/20								Water jacket: K707	108	578
TAW12/35G	For further data see TAL12/35							30	Water jacket: K715	226	650
TB2.5/300	6.3	C telegr.	75	2.5	0.205	0.39	2.5	0.14	An. conn.: 40712		
R.F. power	5.4	C an. mod.	75	2.0	0.255[2])	0.41[2])	2.5	0.14	Socket: 2422 512 01001		
triode		B mod.	—	2.5	0.356[2])	0.70[2])	2.5	0.14			
TB2.5/400	6.3	C telegr.	150	2.5	0.205	0.39	3.0	0.15	An. conn.: 40712		
R.F. power	5.8	C an. mod.	150	2.0	0.128	0.20	2.4	0.10	Socket: 2422 512 01001		
triode		B mod.	—	2.5	0.356[2])	0.70[2])	3.0	0.15			
TB3/750	5	C telegr.	100	4.0	0.38	1.20	4.0	0.35	An. conn.: 40712		
R.F. power	14.1	C osc.	100	4.0	0.76[2])	2.32[2])	4.0	0.35	Chimney: 40666		
triode		B mod.	—	4.0	0.54[2])	1.55[2])	4.0	0.35	Socket: 2422 512 01001		
TB4/1250	10	C telegr.	100	4.0	0.535	1.70	4.0	0.45	An. conn.: 40626		
R.F. power	9.9	C an. mod.	100	3.0	0.450	1.05	3.0	0.30	Socket: 2422 512 00001		
triode		B mod.	—	4.0	0.736[2])	2.30[2])	4.0	0.45			







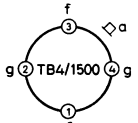


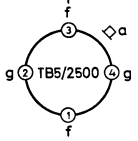
[1]) Per phase. [2]) Two tubes.

TRANSMITTING TUBES - Triodes

Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	I_a (A)	W_o (kW)	Limiting values V_a (kV)	Limiting values W_a (kW)	Accessories	Base connections / Max. dimensions diam.	Max. dimensions length
TB4/1500	5	Ind. osc.	50	5.4	0.320	1.64	6.3	0.5	An. conn.: 40665		
Industrial R.F. power triode	32.5	Ind. osc.	50	4.5	0.380	1.60	6.3	0.5	Socket: 2422 511 05001		
TB5/2500	6.3	Ind. osc.	50	5.4	0.53	2.75	6.3	0.8	An. conn.: 40665		
Industrial R.F. power triode	32.5	Ind. osc.	50	4.5	0.60	2.55	6.3	0.8	Socket: 2422 511 05001		
TBH6/14	as	**TBL6/14**								185	351
TBH6/6000	as	**TBL6/6000**								130	219
TBH7/8000	as	**TBL7/8000**								130	219
TBH7/9000	as	**TBL7/9000**								130	211
TBH12/25	as	**TBL12/25**								185	410
TBH12/38	as	**TBL12/38**								185	422
TBL2/300	3.4	C telegr.	175	2.50	0.26	0.48	2.5	0.3		41.5	72
Air cooled coaxial R.F. power triode	19	C telegr.	900	1.30	0.35	0.16	1.3	0.3			
		Ind. osc.	470	1.75	0.17	0.38	1.8	0.3			

However with integral helical water cooler and different dimensions





TBL2/400 Air cooled coaxial R.F. power triode	3.4 19	C telegr. C telegr. Ind. osc. Ind. osc.	470 810 470 810	2.0 1.8 2.0 1.8	0.40 0.40 0.38 0.38	0.6 0.41 0.48 0.28	2.2 2.0 2.2 2.0	0.4 0.4 0.4 0.4		41.5	83
TBL2/500 Air cooled coaxial R.F. power triode	3.4 19	C telegr. C telegr.	400 625	2.5 2.2	0.38 0.38	0.67 0.58	2.7 2.0	0.5 0.5		41.5	83
TBL6/14 Air cooled industrial R.F. power triode	6.3 130	Ind. osc. Ind. osc.	30 30	7.0 6.0	3.5 3.3	17.7 14.3	8.0 8.0	10 10	Fil. conn.: 40662 Grid conn.: 40664 Ins. pedestal: K508	115	315
TBL6/20 Air cooled coaxial R.F. power triode	6.3 154	C telegr. B teleph.[2]) B teleph.[3])	110 170 −220 170 −220	5.0 4.0 4.0	4.8 4.8 4.8	17 12 12	5.5 4.5 4.5	10 10 10	Fil. conn.: 40652 Fil. conn.: 40653 Grid and anode conn.: 40651 Ins. pedest.: 40654	170	277
TBL6/4000 Air cooled industrial R.F. power triode	6.3 65	Ind. osc. Ind. osc.	50 50	7.0 6.0	0.9 0.9	4.9 4.1	8.0 8.0	1.7 1.7	Socket: 2422 511 05001	86	178
TBL6/6000 Air cooled R.F. power triode	12.6 33	C telegr. C an. mod. B mod.	75 75 —	6.0 5.0 6.0	1.5 1.2 3.0[1])	6.9 4.7 13.3[1])	6.0 5.0 6.0	5.0 3.4 5.0	Fil. conn.: 40634 Grid conn.: 40622 Grid conn.[4]): 40650 Ins. pedest.: 40630	123	195

[1]) Two tubes. [2]) Neg. mod.; pos. sync. [3]) Pos. mod.; neg. sync. [4]) $f = < 30$ MHz.

TRANSMITTING TUBES - Triodes

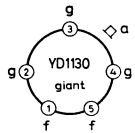
Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	I_a (A)	W_o (kW)	Limiting values V_a (kV)	Limiting values W_a (kW)	Accessories	Base connections / Max. dimensions diam.	Max. dimensions length
TBL7/8000 Air cooled R.F. power triode	12.6 33	C telegr. Ind. osc.	30 50	6.5 6.0	2.0 1.5	9.5 6.0	7.2 7.0	6.0 6.0	Fil. conn.: 40634 Grid conn.: 40622 Grid conn.[2]): 40650 Ins. pedest.: 40630	123	195
TBL7/9000 Air cooled industrial R.F. power triode	12.6 32	Ind. osc. Ind. osc.	50 50	7.2 6.2	1.5 1.4	6.1[3]) 5.0[3])	8.0 8.0	6.0 6.0	Grid and fil. conn.: 40634 Ins. pedestal: 40630	123	186
TBL12/25 Air cooled industrial R.F. power triode	8 98	Ind. osc. Ind. osc.	30 30	12 8	3.2 3.2	29 18	13 13	15 15	Fil. conn.: 40662 Grid conn.: 40663 Ins. pedestal: 40648	198	378
TBL12/38 Air cooled industrial R.F. power triode	8 130	Ind. osc. Ind. osc.	30 30	12 8	4.5 4.5	39 23	13 13	15 15	Fil. conn.: 40662 Grid conn.: 40663 Ins. pedestal: 40648	198	404
TBL12/40 Air cooled R.F. power triode	8 130	C telegr. C an mod. B mod.	30 30 —	12 10 10	4.5 3.5 3.2[1])	41 27 19[1])	13 10 13	15 10 15	Fil. conn.: 40662 Grid conn.: 40663 Ins. pedestal: 40648	225	392
TBL12/100 Air cooled R.F. power triode	17.5 196	C telegr. C an. mod. B mod.	15 15 —	12 10 12	12 10.5 24[1])	108 80 202[1])	13.5 10.0 15.0	45 30 45	Fil. conn.: 40628 Air jacket: K506	286	660

TBL15/125		$V_f = 17.5$ V[4]), $I_f = 196$A; $V_f = 15.5$ V[5]), $I_f = 131$ A For further data see TBL12/100										
TBW6/14 Water cooled		For further data see TBL6/14							15	Water jacket: K720	115	330
TBW6/6000 Water cooled		For further data see TBL6/6000							6	Water jacket: K713	71	190
TBW7/8000 Water cooled		For further data see TBL7/8000								Water jacket: K713	71	190
TBW7/9000 Water cooled		For further data see TBL7/9000								Water jacket: K721	86	224
TBW12/25 Water cooled		For further data see TBL12/25							20	Water jacket: K717	145	376
TBW12/38 Water cooled		For further data see TBL12/38							20	Water jacket: K722	145	422
TBW12/100 Water cooled		For further data see TBL12/100							50	Water jacket: K714	240	620
TBW15/125 Water cooled		$V_f = 17.5$ V[4]), $I_f = 196$ A; $V_f = 15.5$ V[5]), $I_f = 131$ A For further data see TBL12/100							50	Water jacket: K714		
YD1000 Water cooled R.F. power triode	12.6 160	C telegr.	10	15	9.75	120	16	45	Fil. conn.: 40670 Grid conn.: 40671 Water jacket: K724		140	380
		C telegr.	30	8	8.75	55	12.5	45				
		C an. mod.	30	11	7.60	66	11.5	30				
		B mod.	—	12	9.40[1])	78[1])	12	45				

[1]) Two tubes. [2]) $f = < 30$ MHz. [3]) Power in the load. [4]) Single phase filament energizing. [5]) Three phase filament energizing.

TRANSMITTING TUBES - Triodes

Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	I_a (A)	W_o (kW)	Limiting values V_a (kV)	Limiting values W_a (kW)	Accessories	Base connections / Max. dimensions diam.	Max. dimensions length
YD1001 Air cooled		For further data see YD1000						35	Ins. pedestal: 40672	300	380
YD1002 Vapour cooled		For further data see YD1000						60	Vap. cooling system: K728	218	380
YD1010 Water cooled R.F. power triode	18 280	C telegr. C telegr. C an. mod. B mod.	10 30 30 —	15 12 11 12	29.3 24.7 19.0 52.0[1])	360 245 165 450[1])	15 12 11 12	120 120 80 120	Fil. conn.: 40667 Water jacket: K723	218	656
YD1012 Vapour cooled		For further data see YD1010						180	Vap. cooling system: K729	315	650
YD1120 Air cooled R.F. power triode	12.6 33	C telegr. C telegr. C an. mod. B mod.	30 220 75 —	6.0 3.0 5.0 6.0	1.50 1.25 1.20 3.0[1])	6.9 2.7 4.7 13.3[1])	6.2 4.0 5.0 6.0	5.0 5.0 3.4 5.0		119	200
YD1130 R.F. power triode	5 14.1	SSB[2]) SSB[3]) SSB[4]) B mod.	30 30 30 —	2.5 2.5 2.5 3.0	0.07 0.40 0.27 0.67[1])	0 0.64 0.64 1.30[1])	3.0 3.0 3.0 3.0	0.4 0.4 0.4 0.4	An. conn.: 40624 Chimney: 40666 Socket: 2422 512 01001		



YD1140	17.5	C telegr.	30	12	12.0	108	12.5	100	Fil. conn.: 40628	240	620
Water cooled R.F.	196	C an. mod.	30	10	10.5	83	10.5	66	Water jacket: K714		
power triode		Ind. osc.	30	12	14.0	124	13.0	100			
		B mod.	—	10	16.0[1])	106[1])	15.0	100			
YD1141		For further data see YD1140						45	Air jacket: K506	286	660
Air cooled											
YD1150	6.3	Ind. osc.	27.12	6.0	1.0	5	7.2	2.5	Fil. conn.: 40688	123	172
Air cooled R.F.	33	Ind. osc.	160	5.0	1.0	4	6.0	2.5	Fil. conn.[5]): 40689		
industrial									Grid conn.[6]): 40686		
power triode									Grid conn.[7]): 40687		
									Ins. pedest.: 40630		
YD1151		For further data see YD1150							Water jacket: K713	62	172
Water cooled											
YD1152		As YD1150 however with integral								131	207
Water cooled		helical water cooler									
YD1160	6.3	Ind. osc.	27.12	6.5	1.8	9.2	7.2	5.0	Fil. conn.: 40688	123	192
Air cooled	66	Ind. osc.	150	5.0	2.0	7.5	6.0	5.0	Fil. conn.[5]): 40689		
R.F. industrial									Grid conn.[6]): 40686		
power triode									Grid conn.[7]): 40687		
									Ins. pedest.: 40630		
YD1161		For further data see YD1160							Water jacket:	62	192
Water cooled									K726		

[1]) Two tubes. [2]) Zero signal. [3]) Single tone. [4]) Double tone. [5]) Filament cathode connector. [6]) $f = < 30$ MHz. [7]) $f = > 30$ MHz.

Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	I_a (A)	W_o (kW)	Limiting values V_a (kV)	Limiting values W_a (kW)	Accessories	Base connections / Max. dimensions diam.	Max. dimensions length
YD1162 Water cooled		As YD1160 however with integral helical water cooler								131	227
YD1170 Air cooled R.F. industrial power triode	5.8 130	Ind. osc.	120	6.0	3.4	16.2	7.2	10	Fil. conn.: 40692 Fil. conn.: 40693 Grid conn.[1]) : 40690 Grid conn.[2]) : 40691 Ins. pedest.: 40654	159	217
YD1171 Water cooled		For further data see YD1170							Water jacket: K727	84	217
YD1172 Water cooled		As YD1170 however with integral helical water cooler								114	217
YD1173 Air cooled R.F. industrial power triode	5.4 65	Ind. osc.	50	10	1.75	13.7	12	10	Fil. conn.: 40692 Fil. conn.: 40693 Grid conn.[1]) : 40690 Grid conn.[2]) : 40691 Ins. pedest.: 40654	159	217

YD1175 Air cooled R.F. industrial power triode	5,8 130	Ind. osc.	120	10	3,4	27	12	10	Fil. conn. 40692 Fil. conn. 40693 Grid conn. 40690 [1]) Grid conn. 40691 [2]) Ins. pedest. 40654	159	217
YD1177		As YD1175 however with integral helical water cooler								114	217
YD1180 Air cooled R.F. industrial power triode	7.0 175	Ind. osc.	90	7.5	5.4	33	9.0	15	Fil. conn. 40708 Fil. conn. 40709 Grid conn. 40710 [1]) Grid conn. 40711 [2])	192	243
YD1182		As YD1180 however with integral helical water cooler						20		130	270
YD1185 Air. cooled R.F. industrial power triode	7 175	Ind. osc.	90 90	8,5 12	5,4 5,33	34,5 51,2	14,4 14,4	15 15	Fil. conn.: 40708 Fil. conn.: 40709 Grid. conn.: 40710 [1]) Grid conn.: 40711 [2]) Ins. pedest.: 40648	192	243
YD1187		As YD1185 however with integral helical water cooler						20		131	290
YD1192 Water cooled R.F. industrial power triode	8.4 235	Ind. osc.	30	8.0	10	65	9.6	40	Fil. conn.: 40705 Fil. conn.: 40706 Grid conn. [1]) : 40707 Grid conn. [2]) : 40736	160	322

[1]) $f = <4$ MHz. [2]) $f = >4$ MHz.

Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	I_a (A)	W_o (kW)	Limiting values V_a (kV)	Limiting values W_a (kW)	Accessories	Base connections Max. dimensions diam.	Base connections Max. dimensions length
YD1193 Vapour cooled		For further data see YD1192							Boiler: K735	290	283
YD1195 Air cooled R.F. industrial power triode	8,4 235	Ind. osc.	30 30	8,5 12	10 9,75	62,6 92,1	14,4 14,4	30 30	Fil. conn.: 40705 Fil. conn.: 40706 Grid. conn.: 40707 [1] Grid. conn.: 40736 [2] Ins. pedest.: 40729	192	243
YD1197		As YD1195 however with integral helical water cooler						40		161	290
YD1202 Water cooled industrial power triode	12.2 250	Ind. osc. Ind. osc.	30 30	10 12	16 13	124 124	14.4 14.4	80 80	Fil. conn.: 40695 Fil. conn.: 40696 Grid conn. [1]: 40694 Grid conn. [2]: 40737	190	446
YD1203 Vapour cooled		For further data see YD1202							Boiler: K735	290	381
YD1204 Vapour cooled R.F. industrial power triode	12,2 255	Ind. osc.	30 30	10 12	16 13	124 123,5	14,4 14,4	80 80	Fil. conn.: 40695 Fil. conn.: 40696 Grid conn.: 40737	270	381

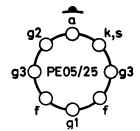
YD1212 Water cooled R.F. industrial power triode	12.6 380	Ind. osc.	30	14	23.5	247	16.8	120	Fil. conn.: 40695 Fil. conn.: 40696 Grid conn.[1]): 40694 Grid conn.[2]): 40737	190	446
YD1213 Vapour cooled		For further data see YD1212							Boiler: K733	290	381
YD1240 Air cooled R.F. industrial power triode	6.3 33	Ind. osc.	27.12 60	5.0 4.5	0.75 0.70	2.9 2.4	5.5 5.5	1.5 1.5	Fil. conn.: 40688 Fil. conn.[3]): 40689 Grid conn.[1]): 40686 Grid conn.[2]): 40687	67	172
YD1300 Air cooled R.F. power triode	5 2.1	R.F. class B transposer service	780	1.7	0.17	0.035[4])	1.8	0.3		45.4	55.2
YD1301 Air cooled R.F. power triode	5 2.1	R.F. class B transposer service	780	1.7	0.185	0.05[4])	1.8	0.3		45.4	55.2
YD1330 Air cooled R.F. power triode	6.3 6.5	R.F. class B transposer service	470 –860	3.0	0.51	0.22[4])	3.5	1.8		71	106
YD1332 Air cooled R.F. power triode	6.3 6.5	R.F. class B transposer service	470 –860	3.0	0.51	0.22[4])	3.5	1.8		95.1	96.5

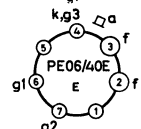
[1]) f = <4 MHz. [2]) f = >4 MHz. [3]) Filament/cathode connector. [4]) Power in load (syn).

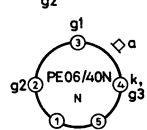
Type and application	V_f (V) / I_f (A)	*Operating conditions*	f (MHz)	V_a (kV)	I_a (A)	W_o (kW)	*Limiting values* V_a (kV)	W_a (kW)	*Accessories*	*Base connections* *Max. dimensions* diam.	length
YD1333 Air cooled R.F. power triode	6.3 5.4	R.F. class B transposer service	470 – 860	2.0	0.41	0.1 [3]	3.5	0.9		71	88.5
YD1342 Water cooled R.F. industrial power triode	14 555	Ind. osc.	30	16	42	489	19.2	240	Fil. conn.: 40695 Fil. conn.: 40696 Grid conn.[1]): 40694 Grid conn.[2]): 40737	230	610
YD1343 Vapour cooled		For further data see YD1342							Boiler: K738	290	525
YD1352S Water cooled magnetically beamed triode	5 6.1	Ind. osc.	5	4.5	0.72	3.1	4.5	2	Magnet assembly: 40765 Grid conn.: 40766	44	164

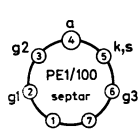
TRANSMITTING TUBES - Tetrodes, Pentodes

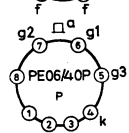
Type and application	V_f (V) / I_f (A)	*Operating conditions*	*f* (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	*Limiting values* V_a (kV)	W_a (W)	*Accessories*	*Base connections* *Max. dimensions* *diam.*	*length*
PE05/25	12.6	C telegr.	100	0.5	250	90	33	0.5	12	Socket:		
R.F. power pentode	0.7	C ag_2 mod.	100	0.4	200	70	20	0.5	12	40210/02		
PE06/40E	12.6	C telegr.	60	0.6	300	195	72	0.6	25	An. conn.:		
R.F. power pentode	0.65	C ag_2 mod.	60	0.5	160[5])	146	40	0.6	25	28906022		
		B mod.	—	0.6	300	230[4])	100[4])	0.6	25	Socket: 40220		
PE06/40N	6.3 / 1.3	For further data see PE06/40E								Socket: 2422 512 03001		
PE06/40P	6.3 / 1.3	For further data see PE06/40E								Socket: 2422 514 00001		
PE1/100	12.6	C telegr.	60	1.0	250	177	132	1.0	45	Socket:		
R.F. power pentode	1.3	C ag_2 mod.	60	0.8	250	120	75	1.0	45	2422 513 00001		
		B mod.	—	1.0	250	268[4])	194[4])	1.0	45			







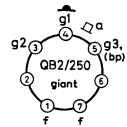


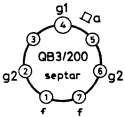


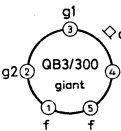
[1]) $f = < 4$ MHz. [2]) $f = > 4$ MHz. [3]) Power in load (syn). [4]) Two tubes. [5]) $R_{g2} = 34$ kΩ.

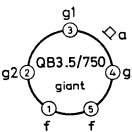
TRANSMITTING TUBES - Tetrodes, Pentodes

Type and application	V_f (V) I_f (A)	Operating conditions	f (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	Limiting values V_a (kV)	Limiting values W_a (W)	Accessories	Base connections Max. dimensions diam.	length
QB2/250	10	C telegr.	30	2.0	400	180	275	2.0	100	An. conn.:		
R.F. beam power pentode	5	C ag_2 mod.	30	1.6	300	150	180	1.6	67	40619		
		AB mod.	—	2.5	750	290[1]	490[1]	2.5	125			
QB3/200	6	C telegr.	50	3.0	250	115	280	3.0	65	An. conn.:		
R.F. power tetrode	3.5	C telegr.	220	1.5	250	117	110	1.5	65	40712		
		C ag_2 mod.	50	2.5	250	110	230	2.5	45	Socket:		
		C ag_2 mod.	220	1.5	250	80	75	1.5	45	2422 513 00001		
		B mod.	—	1.75	500	170[1]	175[1]	3.0	65			
QB3/300	5	C telegr.	120	3.0	350	167	375	3.0	125	An. conn.:		
R.F. power tetrode	6.5	C ag_2 mod.	120	2.5	350	152	300	2.5	83	40712		
		B mod.	—	2.5	600	216[1]	345[1]	3.0	125	Socket: 2422 512 01001		
QB3/300GA		Metal-shell giant base For further data see QB3/300										
QB3.5/750	5	C telegr.	75	4.0	500	312	1000	4.0	250	An. conn.:		
R.F. power tetrode	14.1	C ag_2 mod.	75	3.0	400	225	510	3.2	165	40712		
		B mod.	—	3.0	300	550[1]	1240[1]	4.0	250	Socket: 2422 512 01001		
QB3.5/750GA		Metal-shell Giant base For further data see QB3.5/750										

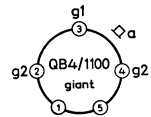


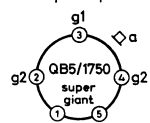


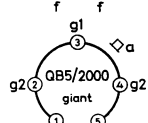




QB4/1100	5	C telegr.	75	4.0	500	350	1100	4.0	400	An. conn.: 40712		
R.F. power	14.1	C telegr.	100	3.5	500	250	650	4.0	400	Chimney: 40666		
tetrode		C ag_2 mod.	75	3.0	500	275	630	3.2	270	Socket:		
		B mod.	—	4.0	750	586[1]	1540[1]	4.0	400	2422 512 01001		
QB4/1100GA		Metal-shell Giant base For further data see QB4/1100										
QB5/1750	10	C telegr.	60	5.0	600	440	1760	5.0	500	An. conn.:		
R.F. power	9.9	C ag_2 mod.	60	4.0	600	380	1200	4.0	330	40626		
tetrode		SSB[2]	30	5.0	700	56	0	5.0	500	Socket:		
		SSB[3]	30	5.0	700	280	900	5.0	500	2422 512 00001		
		B mod.	—	5.0	600	580[1]	2220[1]	5.0	500			
QB5/2000	7.5	C telegr.	30	5.0	600	600	2400	5.5	800	An. conn.:		
R.F. power	22.6	SSB[2]	30	4.0	600	150	0	5.5	800	40665		
tetrode		SSB[4]	30	4.0	600	465	1300	5.5	800	Socket:		
		SSB[3]	30	4.0	600	330	650	5.5	800	2422 512 00001		
QBL3.5/2000	3.6	C telegr.	800	4.3[5]	600[6]	850	2100[7]	4.5	1500		89	215
Coaxial U.H.F. power tetrode	58											
QBL4/800	5	C telegr.	110	4.0	500	315	930	4.0	500		67	120
R.F. power tetrode	13.5	C telegr.	110	2.5	500	310	530	4.0	500			
QBL5/3500	6.3	C telegr.	75	5.0	800	1100	4100	5.0	3000	Fil. conn.: 40634	97	169
Air cooled R.F.	32.5	C telegr.	220	4.0	800	1100	2900	4.0	3000	g2 conn.: 40622		
power tetrode		C ag_2 mod.	110	4.0	800	900	2700	4.0	2000	Ins. pedestal: 40635		

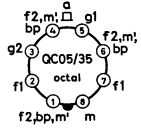


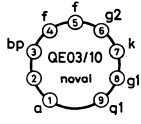


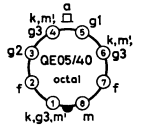


[1]) Two tubes. [2]) Zero signal. [3]) Double tone. [4]) Single tone. [5]) V_{a-g1}. [6]) V_{g2-g1}. [7]) Power in the load

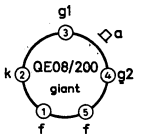
Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	Limiting values V_a (kV)	Limiting values W_a (W)	Accessories	Base connections / Max. dimensions diam.	Max. dimensions length
QBW5/3500 Water cooled		For further data see QBL5/3500								Water jacket: K713	70.5	160
QC05/35 R.F. beam power tetrode for mobile equipment	1.6 / 3.2	C telegr.	60	0.60	180	150	65	0.65	25	An. conn.: 28 906 022 Socket: 2422 501 03001		
		C telegr.	175	0.40	190	150	35	0.65	25			
		C ag_2 mod.	60	0.48	135	94	34	0.48	14			
QE03/10 R.F. tetrode	6 / 0.75	C telegr.	30	0.3	250	50	10	0.3	12	Socket: 2422 502 01003		
		C telegr.	50	0.3	250	50	8	0.3	12			
QE05/40 R.F. beam power tetrode	6.3 / 1.25	C telegr.	60	0.60	150	112	52	0.60	20.0	An. conn.: 28 906 022 Socket: 2422 501 03001		
		C telegr.	175	0.32	180	140	25	0.32	20.0			
		C ag_2 mod.	60	0.48	135	94	34	0.48	13.3			
		AB mod.	—	0.60	180	200[1])	82[1])	0.60	20.0			







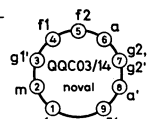
QE05/40F	12.6 0.62	For further data see QE05/40										
QE05/40H	26.5 0.3	For further data see QE05/40										
QE05/40K	13.5 0.58	For further data see QE05/40										
QE08/200 R.F. beam power tetrode	6.3 3.9	C telegr. C ag_2 mod. SSB [2]) SSB [3]) B mod.	30 30 30 30 —	0.75 0.60 0.75 0.75 0.75	250 250 310 310 250	385 300 130 270 560[1])	200 130 0 220 300[1])	1.10 0.65 0.83 0.83 0.83	100 67 100 100 100	An. conn.: 40680 Socket: 2422 512 01001		
QE08/200H	26.5 0.85	For further data see QE08/200										
QEL1/150 Air cooled R.F. power tetrode	6 2.6	C telegr. C ag_2 mod. SSB [2]) SSB [4]) SSB [3])	150 150 175 175 175	2.0 1.6 2.0 2.0 2.0	250 250 300 300 300	250 200 75 250 160	370 230 0 300 150	2.0 1.6 2.0 2.0 2.0	250 165 250 250 250	Chimney: 4322 026 11701 Socket: 2422 513 01001	42	63
QEL1/150H	26.5 0.58	For further data see QEL1/150										

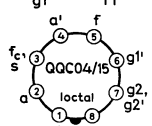


[1]) Two tubes. [2]) Zero signal. [3]) Double tone. [4]) Single tone.

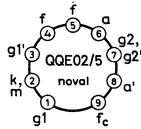
TRANSMITTING TUBES - Tetrodes, Pentodes

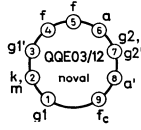
Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	Limiting values V_a (kV)	Limiting values W_a (W)	Accessories	Base connections / Max. dimensions diam.	Max. dimensions length
QEL2/200	6	SSB[1]	30	2.0	400	70	0	2.0	250	Chimney:	42	63
V.H.F./U.H.F.	2.6	SSB[2]	30	2.0	400	350	400[3]	2.0	250	4322 026 11701		
tetrode		SSB[4]	30	2.0	400	225	400[3]	2.0	250	Socket:		
		A.M. teleph.	30	2.0	400	175	105	2.0	250	2422 513 01001		
QEL2/275	6	C telegr.	175	2.0	250	250	390	2.0	250	Chimney:	42	63
V.H.F./U.H.F.	2.6	C telegr.	500	2.0	300	250	250	2.0	250	4322 026 11701		
tetrode		C ag_2 mod.	175	1.5	250	200	235	1.5	165	Socket:		
		SSB[1]	175	2.0	350	100	0	2.0	250	2422 513 01001		
		SSB[2]	175	2.0	350	250	300	2.0	250			
QEL2/275H	26.5 / 0.58	For further data see QEL2/275										
QQC03/14	3.15	C telegr.[5][6]	200	0.25	250[7]	90	11[3]	0.3	14	Tube retainer:		
Quick heating	1.65									40647		
double tetrode										Socket:		
										2422 502 01003		
QQC04/15	3.15	C telegr.[5]	60	0.60	200	60	26.6	0.6	12	Socket:		
Quick heating	1.36 or 6.3	C telegr.[5]	60	0.25	175	60	10.6	0.6	12	2422 501 05001		
double tetrode	0.68											

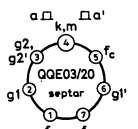


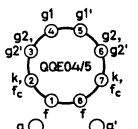


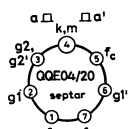
QQE02/5	6.3	C telegr.[5])	500	0.18	180	56	5.8	0.25	6	Socket:
R.F. double	0.6 or	C ag$_2$ mod.[5])	500	0.18	180	40	4.2	0.20	4	2422 502 01003
tetrode	12.6	C freq. mult.[5])	167	0.18	180[8])	40	2.35	0.25	6	
	0.3		−500							
QQE03/12	6.3	C telegr.[5])	200	0.3	175	76	14.5	0.30	10.0	Tube retainer:
R.F. double	0.82	C ag$_2$ mod.[5])	200	0.2	175	86	9.8	0.24	9.2	40647
tetrode	or 12.6	C freq. mult.[5])	67	0.3	150	48	6.5	0.30	10.0	Socket:
	0.41		−200							2422 502 01003
QQE03/20	6.3	C telegr.[5])	200	0.6	250	100	48	0.6	20	An. conn.
R.F. double	1.3 or	C ag$_2$ mod.[5])	200	0.5	250	80	31	0.5	20	40623
tetrode	12.6	C freq. mult.[5])	67	0.3	250	90	10	0.6	20	Socket:
	0.65		−200							2422 513 00001
QQE03/32		See QQE03/20 except for neutralizing cap.								
QQE04/5	6.3	C telegr.[5])	960	0.25	160	70	7.0	0.4	16	Socket:
R.F. double	0.6 or	C freq. mult.[5])	320	0.25	150	76	2.8	0.4	16	B8 700 71
tetrode	12.6		−960							
	0.3									
QQE04/20	6.3	C telegr.[5])	200	0.75	200	48	26	0.75	15	An. conn.:
R.F. double	1.6 or	C telegr.[5])	250	0.40	200	80	17	0.67	15	40615
power tetrode	12.6	C ag$_2$ mod.[5])	200	0.60	200	36	17	0.60	10	Socket:
	0.8									2422 513 00001







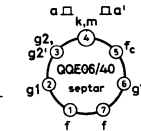


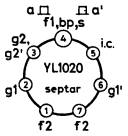
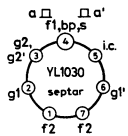
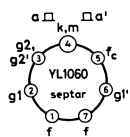
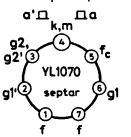


[1]) Zero signal. [2]) Single tone. [3]) Power in the load. [4]) Double tone. [5]) Two systems in push-pull
[6]) Intermittent service. [7]) $R_{g2} = 22$ kΩ. [8]) $R_{g2} = 1.2$ kΩ.

TRANSMITTING TUBES - Tetrodes, Pentodes

Type and application	$V_f(V)$ $I_f(A)$	Operating conditions	f (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	Limiting values V_a (kV)	Limiting values W_a (W)	Accessories	Base connections / Max. dimensions diam.	length
QQE06/40	6.3	C telegr.[6])	200	0.6	250	200	90	0.75	40	An. conn.		
R.F. double	1.8 or	C telegr.[6])	500	0.5	250	200	60	0.60	40	40623		
power tetrode	12.6	C ag_2 mod.[6])	250	0.6	250	150	64	0.60	28	Socket:		
	0.9	B mod.[6])	—	0.6	250	200	86	0.60	40	2422 513 00001		
YL 1000	1.1	C telegr.	50	0.3	150	40	8.0[1])	0.3	5.0	Socket:		
Quick heating	0.88	C telegr.	175	0.3	150	30	3.3[1])			2422 502 01003		
R.F. pentode												
YL1010	10	SSB[2])	30	8.0	1200	2000	0	12	30 kW	Connectors:	140	315
Water	200	SSB[3])	30	8.0	1200	5900	30 kW[5])	12	30 kW	Inner fil.: 40725		
cooled		SSB[4])	30	8.0	1200	3800	30 kW[5])	12	30 kW	Outer fil.: 40726		
coaxial R.F. power tetrode										Grid No. 1: 40727 Grid No. 2: 40728 Water jacket: K732		
YL1011		For further data see YL1010								Ins. pedestal: 40729	215	315
Air cooled												
YL1012		For further data see YL1010							45 kW	Boiler: K728		
Vapour cooled												

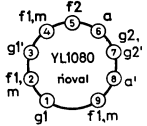


YL1020	1.4	C telegr.[6])	200	0.30	250	100	19	0.60	20	An. conn.: 40623	
Quick	4.0	C telegr.[6])	460	0.40	250	100	21	0.45	20	Socket:	
heating		C ag_2 mod.[6])	200	0.30	250	80	16	0.50	14	2422 513 00001	
R.F. double		C fr. tripler[6])	66.7	0.30	250	90	9	0.60	20		
tetrode			−200								
YL1030	2.1	C telegr.[6])	180	0.40	250	200	53	0.75	40	An. conn.: 40623	
Quick	4.5	C telegr.[6])	475	0.35	250	200	38	0.50	40	Socket:	
heating		C ag_2 mod.[6])	180	0.40	250	150	39	0.60	28	2422 513 00001	
R.F. double		C fr. tripler[6])	50	0.50	250	120	20	0.75	40		
tetrode			−150								
YL1060	6.3	C telegr.[6])	175	1.0	230	200	146	1.0	60	An. conn.: 40681	
R.F. double	1.8 or	C ag_2 mod.[6])	175	0.75	250	180	97	0.8	42	Socket:	
tetrode	12.6									2422 513 00001	
	0.9										
YL1070	6.3	SSB[2])[7])	7	1.0	250	50	0	1.0	60	An. conn.: 40681	
Double	1.8 or	SSB[3])[7])	7	1.0	250	195	141	1.0	60	Socket:	
tetrode	12.6	SSB[4])[7])	7	1.0	250	131	141[5])	1.0	60	2422 513 00001	
	0.9										
YL1071		$V_f = 13.25$ V; $I_f = 0.86$ A or $V_f = 26.5$ V; $I_f = 0.43$ A For further data see YL1070									

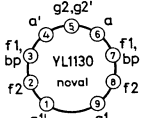
[1]) Power in the load. [2]) Zero signal. [3]) Single tone. [4]) Double tone. [5]) Peak envelope power.
[6]) Two systems in push-pull. [7]) Two sections in parallel.

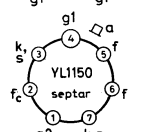
TRANSMITTING TUBES - Tetrodes, Pentodes

Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	Limiting values V_a (kV)	Limiting values W_a (W)	Accessories	Base connections / Max. dimensions diam	Base connections / Max. dimensions length
YL1080 Quick heating R.F. double tetrode	1.6 2.5	C telegr.[1]) C ag_2 mod.[1]) C fr. tripler[1])	200 200 67 – 200	0.3 0.2 0.3	175 200 150	75 68 48	12 [2]) 7.0[2]) 3.5[2])	0.30 0.24 0.30	5.0 3.3 5.0	Retainer: 40647 Socket: 2422 502 01003		
YL1090 Water cooled coaxial R.F. power tetrode	21 350	SSB[3]) SSB[4]) SSB[5]) C ag_2 mod.	30 30 30 30	9 9 9 11	1500 1500 1500 800	5 A 21 A 13.2 A 25 A	0 120 kW[6]) 120 kW[6]) 220 kW	15 15 15 11.5	120 kW 120 kW 120 kW 80 kW	Connectors: 260 Fil.: 40732 (one required) Fil.: 40670 (four required) Grid No. 1: 40733 Grid No. 2: 40734 Water jacket: K734	260	507
YL1091 Vapour cooled		For further data see YL1090							150 kW	Boiler: K729	315	507
YL1100 Air cooled coaxial beam power tetrode	26.5 0.52	C telegr. C telegr. C ag_2 mod. SSB[3]) SSB[5])	400 1200 400 60 60	0.90 0.90 0.70 0.85 0.85	300 300 250 300 300	170 170 130 40 100	80[2]) 40[2]) 45[2]) 0 40[6])	1.0 1.0 0.8 1.0 1.0	115 115 75 115 115		32.2	50
YL1101	6.3 2.1	For further data see YL1100										



YL1102	26.5	For further data see YL1100									28	50
Heatsink	0.52											
cooling												
YL1103	6.3	For further data see YL1100									28	50
Heatsink	2.1											
cooling												
YL1110	6.3	C telegr.	470	2.5	400	500	730 [2]	2.5	700		53	61
Air cooled	7.85	C ag_2 mod.	400	2.0	400	500	600 [2]	2.0	400			
coaxial beam		SSB [3]	30	2.5	450	160	0	2.5	600			
power tetrode		SSB [5]	30	2.5	450	350	680 [6]	2.5	600			
YL1120	12.6	SSB [3]	13	5.0	700	700	0	5.5	4000	Socket: 40682	159	202
Air cooled	14.5	SSB [4]	13	5.0	700	1800	5100 [2][6]	5.5	4000	Air duct: 40683		
coaxial R.F.		SSB [5]	13	5.0	700	1260	5100 [2][6]	5.5	4000	or Ins. pedestal:		
power tetrode										40654		
YL1121	12.6	SSB [3]	30	5.0	650	700	0	5.5	4000	Socket: 40699	159	229
Air cooled	14.5	SSB [4]	30	5.0	650	1850	5000 [2]	5.5	4000	Air duct: 40683		
R.F. power		SSB [5]	30	5.0	650	1300	5000 [6]	5.5	4000	or Ins. pedestal:		
tetrode										40654		
YL1130	1.1	C telegr. [1]	200	0.28	175	84	16	0.3	8.0	Socket:		
Quick heating	2.9	C telegr. [1]	500	0.18	175	80	8.0	0.2	8.0	2422 502 01004		
R.F. double		Freq. tripler [1]	167	0.18	175	60	3.5	0.2	8.0			
tetrode			– 500									
YL1150	6.3	SSB [3]	30	0.6	250	100	0	0.75	75	An. conn.: 40634		
R.F. beam	1.9 or	SSB [4]	30	0.6	250	325	110 [2]	0.75	75	Socket:		
power tetrode	12.6	SSB [5]	30	0.6	250	220	110 [2][6]	0.75	75	2422 513 00001		
	0.95	AB mod.	—	0.6	250	520 [7]	200 [7]	0.75	75			

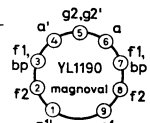


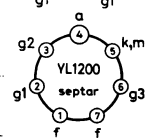


[1]) Two systems in push-pull. [2]) Power in the load. [3]) Zero signal. [4]) Single tone. [5]) Double tone.
[6]) Peak envelope power. [7]) Two tubes in push-pull.

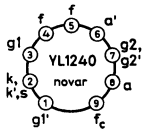
TRANSMITTING TUBES - Tetrodes, Pentodes

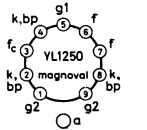
Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	Limiting values V_a (kV)	Limiting values W_a (W)	Accessories	Base connections / Max. dimensions diam.	Max. dimensions length
YL1170		Ruggedized version of QEL2/200										
YL1181 Air cooled coaxial R.F. power tetrode	5	SSB [2]	30	4.5	800	500	0	6.0	4000	Connectors: Fil.: 40721 Grid No. 1: 40722 Grid No. 2: 40723 Ins. pedestal: 40724	100	180
	64	SSB [3] *	30	4.5	800	1330	3000 [1][4]	6.0	4000			
		SSB [5]	30	4.5	800	930	3000 [1][4]	6.0	4000			
YL1182 Vapour cooled		For further data see YL1181							6000	Boiler: K731	122	180
YL1190 Quick heating R.F. double tetrode	1.1	C telegr. [6]	200	0.35	170	140	33	0.4	16	Socket: 2422 502 05001		
	4.2	C telegr. [6]	500	0.26	170	140	19	0.3	16			
		C ag_2 mod. [6]	175	0.28	150	100	19	0.33	11			
YL1200 R.F. power pentode	12.6 / 1.3	SQ tube for special pulse or static application								Socket: 2422 513 00001		
YL1210		$V_f = 6.75$ V; $I_f = 0.72$ A or $V_f = 13.5$ V; $I_f = 0.36$ A For further data see QQE03/12										





YL1220		$V_f = 6.75$ V; $I_f = 0.56$ A or $V_f = 13.5$ V; $I_f = 0.28$ A For further data see QQE02/5										
YL1230	5	SSB[2])	1–30	3.0	560	380	0	3.5	1500	Socket: 40704	95.3	85
Air cooled	18	SSB[3])	1–30	3.0	560	750	1050[1])	3.5	1500			
R.F. power		SSB[5])	1–30	3.0	560	570	1050[1])[4])	3.5	1500			
tetrode												
YL1240	6.75	C telegr.[6])	175	0.40	180	90	21[1])	0.40	15	Socket:		
R.F. double	0.8 or	C ag_2 mod.[6])	175	0.32	140	76	13.5[1])	0.32	10	B8 702 16		
tetrode	13.5	C fr. tripler[6])	58	0.35	165	86	10[1])	0.45	15			
	0.4		−174									
YL1250	6.75	C telegr.	75	0.55	235	136	52[1])	0.55	25	Socket:		
R.F. beam	1.2 or	C telegr.	175	0.40	230	150	38[1])	0.45	25	40685		
power	13.5											
tetrode	0.6											
YL1290	19	For further data see QE08/200										
	2.3											

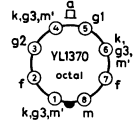




[1]) Power in the load. [2]) Zero-signal. [3]) Single tone. [4]) Peak envelope power output. [5]) Double tone.
[6]) Two systems in push-pull.

TRANSMITTING TUBES - Tetrodes, Pentodes

Type and application	V_f (V) / I_f (A)	Operating conditions	f (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	Limiting values V_a (kV)	Limiting values W_a (W)	Accessories	Base connections Max. dimensions diam.	Base connections Max. dimensions length
YL1320	6	C telegr.	175	2.0	200	250	270	2.0		Socket: 40739	41.6	62.6
Heatsink cooled R.F. power tetrode	2.6	C telegr.	470	0.8	[6]	250	100	2.0				
YL1340	6	SSB [1]	30	2.2	300	100	0	2.5	350	Chimney:	42	63
Air cooled R.F. beam power tetrode	3.2	SSB [2]	30	2.2	300	215	318[4] [5]	2.5	350	4322 026 11701		
		SSB [3]	30	2.2	300	167	318[4] [5]	2.5	350	Socket:		
		AB mod.	—	2.2	400	580[7]	770[7]	2.5	350	2422 513 01001		
YL1341	26.5 / 0.73	For further data see YL1340										
YL1360	13.5 / 0.28	For further data see QQE04/5										
YL1370	6.3	C telegr.	60	0.60	200	150	63	0.60	27	Socket:		
R.F. beam power tetrode	1.125	C ag_2 mod.	60	0.48	165	125	42	0.48	18	2422 501 03001		
		SSB [1]	30	0.60	200	24	0	0.60	27			
		SSB [2]	30	0.60	200	125	49[5]	0.60	27			
		SSB [3]	30	0.60	200	86	49[5]	0.60	27			

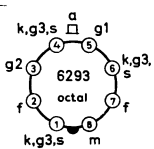


YL1371	12.6 0.562	For further data see YL1370										
YL1372	26.5 0.3	For further data see YL1370										
YL1420 Air cooled V.H.F. power tetrode	6.3 120	Class AB Class B	175 2 0	4.0 5.5	600 600	1900 1700	6250[4])[8]) 6300[4])	6.5 6.5	6000 6000	Socket: 40742 Tube extractor: 40754	125	174
YL1430 Air cooled V.H.F. power tetrode	8.0 120	Class AB Class B	175 260	6 7.5	650 650	2500 2500	12.5 kW[4])[8]) 13 kW[4])	9.0 9.0	12 kW 12 kW	Socket: 40742 Tube extractor: 40754	164	211
YL1440 Air cooled V.H.F. power tetrode	4.2 53	Class AB Class AB Class B	175 175 260	3.0 2.5 3.5	500 500 500	700 600 900	1550[4])[8]) 700[4])[8]) 2200[4])	4.0 4.0 4.0	1500 1500 1500	Socket: 40742 Tube extractor: 40754	64	125
YL1460 R.F. power tetrode		Mesh-type cathode version of QB4/1100 For further data see QB4/1100										
YL1461 R.F. power		Mesh-type cathode version of QB4/1100GA For further data see QB4/1100										

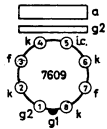
[1]) Zero signal. [2]) Single tone. [3]) Double tone. [4]) Power in the load. [5]) Peak envelope power output.
[6]) Adjust for operating conditions. [7]) Two tubes in push-pull. [8]) $W_{I_{sync.}}$

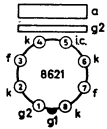
TRANSMITTING TUBES - Tetrodes, Pentodes

Type and application	V_f (V) / I_f (A)	*Operating conditions*	f (MHz)	V_a (kV)	V_{g2} (V)	I_a (mA)	W_o (W)	*Limiting values* V_a (kV)	W_a (W)	*Accessories*	*Base connections* / *Max. dimensions* diam.	length
YL1470 Air cooled V.H.F. power tetrode	6.8 120	Class B	110 110	6.0 7.0	500 550	1500 2200	6.6[4] 10.5[4]	8.4	6000	Socket: 40742 Tube extractor: 40754	125	174
YL1520 Air cooled V.H.F. power tetrode	11.5 120	Class AB	175	8.0	700	900	27.5 kW[4][7]	9.0	18 kW	Socket: 40742 Tube extractor: 40754	165	226
6293 Beam power tetrode	6.3 1.25	For use as a pulse modulator tube in both fixed and mobile equipment $V_{ba}=3$ kV; $V_{bg2}=300$ V; $V_{g1p}=65$ V; $R_l=1.5$ kΩ; $I_{ap}=1.5$ A.										



7609	26.5	C telegr.	150	2.0	250	250	370	2.0	250	Chimney:
Air cooled	0.57	C ag_2 mod.	150	1.6	250	200	230	1.6	165	4322 026 11701
R.F. power		AB mod.	—	2.0	300	470[6])	580[6])	2.0	250	Socket:
tetrode										2422 513 01001
8621	25.6	SSB[1])	7	2.0	350	100	0	2.0	250	Chimney:
Air cooled	0.56	SSB[2])	7	2.0	350	250	270[4])[5])	2.0	250	4322 026 11701
R.F. power		SSB[3])	7	2.0	350	174	270[4])[5])	2.0	250	Socket:
tetrode										2422 513 01001





[1]) Zero signal. [2]) Single tone. [3]) Double tone. [4]) Power in the load. [5]) Peak envelope power. [6]) Two tubes. [7]) $W_{t\,sync}$.

MICROWAVE TUBES - Pulsed magnetrons

Type	V_f (V) I_f (A)	*Frequency (GHz)* *Pulse duration (μs)* *Duty factor*	*Characteristics*	*Limiting values*
JP8-02B	6.3 1.2	8.77–8.83 4 0.4	V_{ap} = 0.8 kV I_{ap} = 0.15 A W_{op} = 25 W	I_{ap} = 0.18 A T_{imp} = 5 μs δ = 0.5
JP9-2.5D **JP9-2.5E**	6.3 0.5	9.415–9.475 0.1 0.0002	V_{ap} = 3.6 kV I_{ap} = 3 A W_{op} = 4 kW	I_{ap} = 3.5 A T_{imp} = 1.0 μs δ = 0.001
JP9-7A air cooled	6.3 0.6	9.21 –9.27 1 0.001	V_{ap} = 5.5 kV I_{ap} = 4.5 A W_{op} = 7.5 kW	I_{ap} = 5.5 A T_{imp} = 2.5 μs δ = 0.0025
JP9-7D air cooled	6.3 0.55	9.345 –9.405 0.1 0.0001	V_{ap} = 5.7 kV I_{ap} = 6.0 A W_{op} = 9.5 kW	I_{ap} = 7.0 A T_{imp} = 1.0 μs δ = 0.002
JP9-15 **JP9-15B**	6.3 0.55	9.345 –9.405 9.415 –9.475 0.1 0.0002	V_{ap} = 7.6 kV I_{ap} = 7.5 A W_{op} = 21 kW	I_{ap} = 9.0 A T_{imp} = 2.5 μs δ = 0.0015

JP9-18	6.3 0.55	9.38–9.44 0.1 0.0002	V_{ap} = 7.2 kV I_{ap} = 8.6 A W_{op} = 21 kW	I_{ap} = 10 A T_{imp} = 2.5 μs δ = 0.0015
JP9-75	10 2.85	9.345–9.405 0.1 0.0002	V_{ap} = 15 kV I_{ap} = 15 A W_{op} = 80 kW	I_{ap} = 17 A T_{imp} = 5.5 μs δ = 0.002
YJ1000	6.3 0.5	9.19 –9.32 0.1 0.0002	V_{ap} = 3.4 kV I_{ap} = 3.0 A W_{op} = 3 kW	I_{ap} = 3.5 A T_{imp} = 1.0 μs δ = 0.001
YJ1010 **YJ1011** tunable air cooled	13.75 3.1	8.5 –9.6 0.6 0.001	V_{ap} = 21.5 kV I_{ap} = 27.5 A W_{op} = 225 kW	I_{ap} = 30 A T_{imp} = 2.75 μs δ = 0.0011
YJ1020	4.0 3.4	32.7 –33.4 0.04 0.0001	V_{ap} = 12.5 kV I_{ap} = 10.5 A W_{op} = 25 kW	I_{ap} = 16 A T_{imp} = 0.05 μs δ = 0.0003
YJ1021	4.0 3.4	32.7 –33.4 0.1 0.0002	V_{ap} = 12.5 kV I_{ap} = 12.5 A W_{op} = 30 kW	I_{ap} = 16 A T_{imp} = 0.5 μs δ = 0.0003
YJ1030	5.0 0.5	5.4–5.9 1.0 0.002	V_{ap} = 1.2 kV I_{ap} = 0.8 A W_{op} = 160 W	I_{ap} = 1.0 A T_{imp} = 3.0 μs δ = 0.002
YJ1040	6.3 0.55	9.345–9.405 2.2 0.00088	V_{ap} = 6.5 kV I_{ap} = 5.75 A W_{op} = 14 kW	I_{ap} = 6.5 A T_{imp} = 2.5 μs δ = 0.0015

MICROWAVE TUBES - Pulsed magnetrons

Type	V_f (V) I_f (A)	*Frequency (GHz)* *Pulse duration (μs)* *Duty factor*	*Characteristics*	*Limiting values*
YJ1060	6.3 0.55	9.345 –9.405 2.5 0.001	V_{ap} = 7.2 kV I_{ap} = 7.5 A W_{op} = 20 kW	I_{ap} = 8.0 A T_{imp} = 2.5 μs δ = 0.002
YJ1071	6.3 0.55	9.380 –9.440 0.1 0.0001	V_{ap} = 5.7 kV I_{ap} = 6 A W_{op} = 10.5 kW	I_{ap} = 7.0 A T_{imp} = 1 μs δ = 0.002
YJ1110	6.3 0.55	9.345 –9.405 0.1 0.0001	V_{ap} = 7.8 kV I_{ap} = 7.5 A W_{op} = 20 kW	I_{ap} = 9.0 A T_{imp} = 2.5 μs δ = 0.0015
YJ1120	6.3 0.55	9.38 – 9.44 1 0.0005	V_{ap} = 8.2 kV I_{ap} = 8.0 A W_{op} = 25 kW	I_{ap} = 10 A T_{imp} = 2 μs δ = 0.0015
YJ1121	6.3 0.55	9.415–9.475 0.75 0.0005	V_{ap} = 8.3 kV I_{ap} = 9.0 A W_{op} = 26 kW	I_{ap} = 10 A T_{imp} = 2.0 μs δ = 0.0015
YJ1140 air cooled	12.6 3.2	16.35–16.65 0.5 0.0004	V_{ap} = 12 kV I_{ap} = 15 A W_{op} = 45 kW	I_{ap} = 15 A T_{imp} = 1 μs δ = 0.001
YJ1180 spin tuned	13,75 3,15	8·7–9,5 1 0,001	V_{ap} = 22,5 kV I_{ap} = 27,5 A W_{op} = 200 kW	I_{ap} = 27,5 A T_{imp} = 1,6 μs δ = 0,0011

YJ1181 [1])	as YJ1180			
YJ1182 [1])		9,25–9,5	for further data see YJ1180	
YJ1200	12.4 2.2	9.345–9.405 4 0.0016	V_{ap} = 12 kV I_{ap} = 12 A W_{op} = 50 kW	I_{ap} = 14 A T_{imp} = 5 μs δ = 0.0025
YJ1290	6.3 1.0	9.415–9.475 0.5 μs 0.00062	V_{ap} = 14 kV I_{ap} = 14 A W_{op} = 65 kW	I_{ap} = 16 A T_{imp} = 1 μs δ = 0.001
YJ1300	6.3 0.55	9.38–9.44 1 0.0002	V_{ap} = 4.25 kV I_{ap} = 5 A W_{ap} = 7 kW	I_{ap} = 6 A T_{imp} = 1 μs δ = 0.001
YJ1320 spin tuned	12,6 1	15,9–17,1 1 0,001	V_{ap} = 15,5 kV I_{ap} = 15 A W_{ap} = 65 kV	I_{ap} = 17 A T_{imp} = 1,1 μs δ = 0,0014
YJ1321 [1])	as YJ1320			
2J42	6.3 <0.6	9.345–9.405 1 0.001	V_{ap} = 5.5 kV I_{ap} = 4.5 A W_{op} = 7.5 kW	I_{ap} = 5.5 A T_{imp} = 2.5 μs δ = 0.0025
2J51A tunable air cooled	6.3 1.0	8.5 –9.6 0.1 0.00033	V_{ap} = 14 kV I_{ap} = 14 A W_{op} = 60 kW	I_{ap} = 15.5 A T_{imp} = 3.6 μs δ = 0.0012
2J55	6.3 1.0	9.345–9.405 1 0.0009	V_{ap} = 12 kV I_{ap} = 12 A W_{op} = 50 kW	I_a = 16 A T_{imp} = 2.5 μs δ = 0.001

[1]) With adjustable fixed frequency lock.

MICROWAVE TUBES - Pulsed magnetrons

Type	V_f (V) I_f (A)	*Frequency (GHz)* *Pulse duration (μs)* *Duty factor*	*Characteristics*	*Limiting values*
4J50	13.75 3.5	9.345–9.405 1 0.001	V_{ap} = 21.5 kV I_{ap} = 27.5 A W_{op} = 225 kW	I_{ap} = 27.5 A T_{imp} = 1.2 μs δ = 0.002
4J52A air cooled	12.6 2.2	9.345–9.405 4–5 0.001	V_{ap} = 15 kV I_{ap} = 15 A W_{op} = 80 kW	I_{ap} = 16 A T_{imp} = 5 μs δ = 0.003
5J26 tunable air cooled	23.5 2.2	1.22 –1.35 1 0.001	V_{ap} = 28 kV I_{ap} = 46 A W_{op} = 450 kW	I_a = 55 A T_{imp} = 1–6 μs δ = 0.0025
725A air cooled	6.3 1.0	9.345–9.405 1 0.0012	V_{ap} = 12 kV I_{ap} = 12 A W_{op} = 50 kW	I_{ap} = 16 A T_{imp} = 2.5 μs δ = 0.0012
5586 tunable air cooled	16 3.2	2.700–2.900 1 0.0005	V_{ap} = 28.5 kV I_{ap} = 70 A W_{op} = 800 kW	I_{ap} = 70 A T_{imp} = 2.5 μs δ = 0.001
6972 air cooled	10 3.25	9.345–9.405 0.1 0.0002	V_{ap} = 15 kV I_{ap} = 15 A W_{op} = 80 kW	I_{ap} = 18 A T_{imp} = 5.5 μs δ = 0.002

7028	6.3 0.5	9.345–9.475 0.1 0.0002	V_{ap} = 3.4 kV I_{ap} = 3.0 A W_{op} = 3.0 kW	I_{ap} = 3.5 A T_{imp} = 0.02–1.0 μs δ = 0.001
7093 air cooled	5.0 3.9	34.512–35.208 0.1 0.0002	V_{ap} = 12.5 kV I_{ap} = 12.5 A W_{op} = 40 kW	I_{ap} = 16 A T_{imp} = 0.4 μs δ = 0.0003
55029 **55030** **55031/02** **55031/01** **55032/02** **55032/01** air-cooled	13.75 3.0–3.75	9.405–9.505 9.345–9.405 9.260–9.345 9.168–9.260 9.085–9.168 9.003–9.085 0.25 0.0005	V_{ap} = 21.5 kV I_{ap} = 24 A W_{op} = 220 kW	I_{ap} = 27.5 A T_{imp} = 1 μs δ = 0.001

MICROWAVE TUBES - Continuous-wave magnetrons

Type	V_f (V) I_f (A)	*Frequency* (GHz)	*Characteristics*	*Limiting values*
DX206 air cooled	4.0 30	2.425–2.475	V_a = 5.4–5.8 kV I_a = 380 mA W_o = 1.2 kW	I_{ap} = 1.3 A
JPT9-01 tunable air cooled	6.3 1.2	9.15–9.60	V_a = 0.9– – 1.1 kV I_a = 50 mA W_o = 10 W	I_{ap} = 0.1 A
YJ1160 water cooled	4.8 35	2.425–2.475	V_a = 4.45–4.85 kV I_a = 750 mA W_o = 2.0 kW	I_{ap} = 2.1 A
YJ1162 air cooled	4.8 35	2.425–2.475	V_a = 4.45–4.85 kV I_a = 750 mA W_o = 2.0 kW	I_{ap} = 2.1 A
YJ1191 Water and air cooled	5.5 46	2.425–2.475	V_a = 6.8–7.2 kV I_a = 1.25 A W_o = 5.5 kW	I_{ap} = 2.6 A
YJ1280 air cooled	5.0 28	2.425–2.475	V_a = 5.4–5.8 kV I_a = 380 mA W_o = 1.5 kW	I_{ap} = 0.8 A
YJ1420 air cooled	3,1 13,5	2,43–2,47	V_a = 4 kV I_a = 340 mA W_o = 950 W	I_{ap} = 0,6 A

YJ1440 air cooled	5,0 39	2,435–2,465	V_a = 5,3 kV I_a = 730 mA W_o = 2,5 kW	I_{ap} = 1,35 A
7090	5.3 3.5	2.425–2.475	V_a = 1.65 kV I_a = 200 mA W_o = .0.2 kW	I_{ap} = 1.4 A

MICROWAVE TUBES - Klystrons

Type	V_f (V) I_f (A)	*Frequency* (GHz)	*Characteristics*	*Limiting values*
KS9-20B tunable	6.3 0.45	9.32–9.55	W_o = 45 mW V_{res} = 300 V	V_{kf} = 50 V t = 110°C
KS9-20D tunable	6.3 0.5	9.325–9.500	W_o = 45 mW V_{res} = 300 V	V_{kf} = 50 V t = 110°C
KS9-40 tunable	6.3 0.5	9.3–9.5	W_o = 40 mW V_{res} = 300 V	V_{kf} = 50 V t_{shell} = 150°C
KS9-40B tunable	6.3 0.5	9.35–9.55	W_o = 45 mW V_{res} = 300 V	V_{kf} = 50 V t = 150°C
KS9-40D tunable	6.3 0.5	9.38–9.51	W_o = 40 mW V_{res} = 300 V	V_{kf} = 50 V t_{shell} = 150°C
YK1000 [3] **YK1004** [3]	7.5 32	0.4–0.62 0.61–0.79	W_o = 11 kW Gain = 30 dB	Coll. dissip. = 50 kW
YK1001 [1] **YK1002** [2]	7.5 32	0.47–0.86	W_o = 11 kW Gain = 30 dB	Coll. dissip. = 36 kW Coll. dissip = 40 kW
YK1005	7.5 32	0.47–0.86	W_o = 11 kW Gain = 40 dB	Coll. dissip. = 40 kW
YK1010 tunable	3.5 1.75	67–74	W_o = 130 mW V_{res} = 2.5 kV	t_{res} = 80°C

YK1090 [4]	6.3	10.5–12.2	W_o = 400 mW	t = 200°C
tunable	1.2		V_{res} = 400 V	
YK1091	6.3	10.5–12.2	W_o = 400 mW	t = 200°C
tunable	1.2		V_{res} = 400 V	
YK1110	3.8	2.993–3.003	W_{op} = 6 MW	W_{op} = 8 MW
	76		Gain = 30 dB	
YK1151	7.8	0.47–0.86	W_o = 23 kW	Coll. dissip. = 65 kW
air cooled	32		Gain = 40 dB	
YK1190	8,5	0,47–0,61	W_o = 45 kW	Coll. dissip. = 150 kW
vapour cooled	31		Gain = 40 dB	
YK1191	8,5	0,59–0,72	W_o = 45 kW	Coll. dissip. = 150 kW
vapour cooled	31		Gain = 44 dB	
2K25	6.3	8.50–9.66	W_o = 45 mW	V_{kf} = 50 V
tunable	0.45		V_{res} = 300 V	t_{shell} = 110°C
723A/B	6.3	8.702–9.548	W_o = 40 mW	V_{kf} = 50 V
tunable	0.45		V_{res} = 300 V	t_{shell} = 110°C
55335	6.3	31–36	W_o = 150 mW	t = 80°C
tunable	0.8		V_{res} = 2.25 kV	

[1]) Air cooled drift tubes and cooled collector. [2]) Air cooled drift tubes and water cooled collector.
[3]) Water cooled collector, drift tubes and output resonator. [4]) Ruggedized.

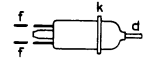
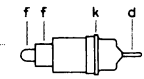
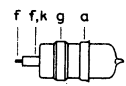
MICROWAVE TUBES - Travelling-wave tubes

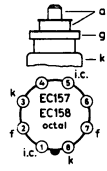
Type	V_f (V) I_f (A)	*Frequency* (GHz)	*Characteristics*	*Limiting values*
LB6-25	6.3 0.95	5.925–6.425	$W_{o\,sat.} = 25$ W Gain = 38 dB	$t_{amb} = -10$ to $+65$°C
YH1090	6.3 1.0	3.4–4.2	$W_{o\,sat.} = 25$ W Gain = 42 dB	$t_{coll.} = 140$°C I_k = 65 mA
YH1170	6.3 1.0	5.8–8.5	$W_{o\,sat.} = 20$ W Gain = 45 dB	$t_{coll.} = 150$°C I_k = 60 mA
YH1172	6.3 1.0	7.0–8.0	$W_{o\,sat.} = 22$ W Gain = 45 dB	$t_{coll.} = 150$°C I_k = 58 mA
YH1210	6.5 3.2	0.47–0.86	W_o = 220 W [1]) Gain = 30 dB	$t_{coll.} = 200$°C I_k = 1 A
7537	6.3 0.8	4.4–5.0	$W_{o\,sat.} = > 6$ W Gain = > 36 dB	$t_{coll.} = 175$°C I_k = 55 mA
55340	6.3 0.8	3.8–4.2	$W_{o\,sat.} = > 8$ W Gain = > 39 dB	$t_{coll.} = 175$°C I_k = 55 mA

MICROWAVE TUBES - Dual T.R. switch

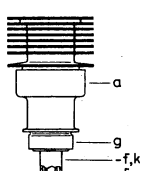
56032		8.49–9.58	$W_p = 3$–250 kW

[1]) With phase compensation unit type 55382.

Type and application	V_f (V) I_f (A)	*Characteristics data*			*Limiting values*	*Base connections*
		Typical				
EA52 **EA53** Measuring diodes	6.3 0.3	I_d = 0.5 mA	V_d = < 3 V		V_{dinvp} = 1 kV I_k = 0.3 mA I_{kp} = 5 mA f = 1 GHz	EA52
		Typical				
EC55 U.H.F. disc seal triode	6.3 0.4	V_a = 250 V V_g = −3.5 V	I_a = 20 mA S = 6 mA/V	μ = 30	V_a = 350 V I_k = 40 mA W_a = 10 W W_g = 0.1 W	EA53
		Typical	*Operating*			
EC157 Disc seal triode (metal-glass)	6.3 0.75	V_a = 180 V I_a = 60 mA V_g = −1.25 V S = 21 mA/V μ = 43	f = 4 GHz V_{ba} = 200 V I_a = 30 mA B = 50 MHz W_o = 0.5 W G = 6 dB	f = 4 GHz V_{ba} = 200 V I_a = 60 mA B = 50 MHz W_o = 1.8 W G = 8 dB	V_a = 300 V I_k = 70 mA W_a = 12.5 W W_g = 0.2 W	EC55

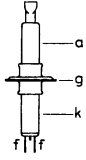


Type and application	V_f (V) I_f (A)	*Characteristics data*			*Limiting values*	*Base connections*
		Typical	*Operating*			
EC158 Disc seal triode (metal glass)	6.3 0.9	V_a = 180 V I_a = 140 mA S = 28 mA/V μ = 30	f = 4 GHz V_{ba} = 200 V I_a = 140 mA	B = 50 MHz W_o = 5.3 W G = 6 dB	V_a = 300 V I_k = 170 mA W_a = 30 W	
		Typical				
K50A Rare gas-filled noise diode	2.0 2.0	V_a = 165 V I_a = 125 mA	t_F = 21700K F = 18.75 dB	V_{ign} = > 6 kV λ = 3 cm	I_a = min. 50 mA max. 150 mA t_{amb} = −55°C +75°C	Diam. Length 14 258
		Typical				
K51A Rare gas-filled noise diode	2.0 3.5	V_a = 140 V I_a = 200 mA	t_F = 16600 K F = 17.58 dB	V_{ign} = > 6 kV λ = 10 cm	I_a = min. 100 mA max. 300 mA t_{amb} = −55°C +75°C	Diam. Length > 17 517
		Typical	*C.W. oscillator*			
YD1050 Disc seal triode	6.0 0.98	V_a = 500 V I_a = 100 mA S = 27 mA/V μ = 60	f = 0.5 V_a = 600 I_a = 80 W_o = 26	2.5 GHz 600 V 100 mA 16 W	V_a = 1 kV I_k = 125 mA W_a = 100 W f = 2.5 GHz	



YD1050
YD1051
2C39A

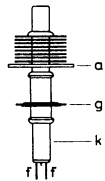
		Typical	*C.W. oscillator*	*Amplifier*	
YD1051	6,0	$V_a = 500$ V	$f = 0{,}7$	0,71 GHz	$V_a = 1$ kV
Disc seal	0,98	$I_a = 100$ mA	$V_a = 850$	850 V	$I_k = 190$ mA
triode		$S = 30$ mA/V	$I_a = 100$	100 mA	$W_a = 100$ W
		$\mu = 75$	$W_o = 30$	17 W	$f = 2{,}5$ GHz
		Typical	*C.W. oscillator*	*Freq. doubler*	
2C39A	6.3	$V_a = 600$ V	$f = 2.5$ GHz	$f = 1$–2 GHz	$V_a = 1$ kV
Disc seal	1.03	$I_a = 75$ mA	$V_a = 800$ V	$V_a = 400$ V	$I_k = 125$ mA
power triode		$S = 25$ mA/V	$I_a = 100$ mA	$I_a = 55$ mA	$W_a = 100$ W
(air cooled)		$\mu = 100$	$W_o = 18$ W	$W_o = 4.1$ W	$f = 3.0$ GHz
2C39BA	6.0		$W_o = 24$ W	$W_o = 5.2$ W	$f = 3.5$ GHz
	0.98	for further data see 2C39A			
		Typical			
5876	6.3	$V_a = 250$ V	$I_a = 18$ mA	$R_i = 8.6$ kΩ	$V_a = 360$ V
Pencil type	0.135	$R_k = 75$ Ω	$S = 6.5$ mA/V	$\mu = 56$	$I_a = 25$ mA
UHF high-					$W_a = 6.25$ W
mu triode					$f = 1.7$ GHz
5876A	ruggedized version of the 5876				
		Typical			
5893	6.0	$V_a = 200$ V	$I_a = 25$ mA	$R_i = 4.5$ kΩ	$V_a = 330$ V
Pencil type	0.28	$R_k = 100$ Ω	$S = 6$ mA/V	$\mu = 27$	$I_a = 35$ mA
UHF medium-					$W_a = 7$ W
mu triode					$f = 3.3$ GHz



5876
5893

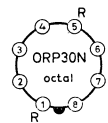
MICROWAVE TUBES - Diodes and Triodes

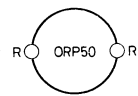
Type and application	V_f (V) I_f (A)	*Characteristics data*			*Limiting values*	*Base connections*
		Typical				
6263 Pencil type UHF medium-mu triode	6.0 0.28	V_a = 200 V R_k = 100 Ω	I_a = 27 mA S = 7 mA/V	R_i = 3.8 kΩ μ = 27	V_a = 330 V I_a = 40 mA W_a = 8 W f = 1.7 GHz	
6263A	ruggedized version of the 6263					
		Typical				
6264 Pencil type UHF medium-mu triode	6.0 0.28	V_a = 200 V R_k = 100 Ω	I_a = 18.5 mA S = 6.8 mA/V	R_i = 5.9 μ = 40	V_a = 330 V I_a = 40 mA W_a = 8 W f = 1.7 GHz	
6264A	ruggedized version of the 6264					
7289	ruggedized version of the 2C39BA					
8108	ruggedized version of the EC157					

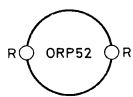


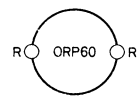
6263.
6264

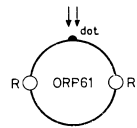
PHOTOSENSITIVE DEVICES - Cadmium sulphide photoconductive cells

Type	$P_{max.}$ *at* $T_{amb}=25°C$	*Cell voltage d.c. and repetitive peak (max.)*	*Cell resistance at 50 lux ; 2700 K colour temp.*	*Sensitive area*	*Max. dimensions*		*Base connections*
					diam.	*length*	
ORP30N[1]	1.5 W	350 V	330 Ω	4.5 cm²	34.5	70	
ORP50[1][2]	360 mW	300 V	2.7 kΩ	50 mm²	16	44	
ORP52[1]	400 mW	200 V	1.2 kΩ	50 mm²	16	44	
ORP60[1] **ORP61**[2]	70 mW	350 V	60 kΩ	0.25 mm²	6	15,5	



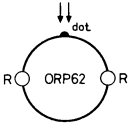


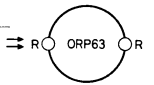


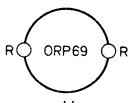


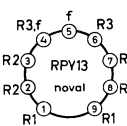
ORP62[2])	100 mW	350 V	46 kΩ	1.5 mm²	6	15,5
ORP63[2])	75 mW	100 V	1.6 kΩ	15 mm²	6	26
ORP69[1])[2])	100 mW	350 V	30 kΩ		6	15,5
ORP90[2])	1 W	350 V	1 kΩ	3.2 cm² (total area)	19	60.3
RPY13 CdS cells-lamp combination	150 mW (each cell)	200 V	15 Ω	lamp filam. $V_f = 24$ V $I_f = 54$–66 mA	22	55.6
RPY18[2])	500 mW 2 W[3])	100 V	25 Ω	1.5 cm² (total area)	16.3 × 6	27
RPY19[2])	500 mW 2 W[3])	400 V	3 kΩ	1.5 cm² total area	16.3 × 6	27

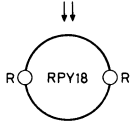
[1]) Top sensitivity. [2]) Side sensitivity. [3]) With a heatsink with $K = 5$ °C/W.

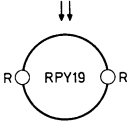






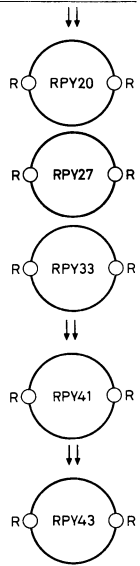


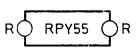


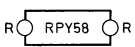


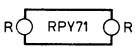
PHOTOSENSITIVE DEVICES - Cadmium sulphide photoconductive cells

Type	*$P_{max.}$ at $T_{amb}=25°C$*	*Cell voltage d.c. and repetitive peak (max.)*	*Cell resistance at 50 lux; 2700 K colour temp.*	*Sensitive area*	*Max. dimensions*		*Base connections*
					diam.	*length*	
RPY20[2])	1 W 3 W[3])	400 V	1.5 kΩ	3 cm^2 (total area)	16.3 × 6	43	
RPY27[1])	1 W	400 V	650 Ω	3.2 cm^2 (total area)	32	23	
RPY33[1])	75 mW	50 V	1,65 to 5,1 kΩ[5])	15 mm^2	9.4	3.4	
RPY41[2])	225 mW	100 V	1.6 kΩ	64 mm^2 (total area)	10.3 × 4.3	22	
RPY43[2])	750 mW	400 V	1.5 kΩ		13.5 × 2	30.5	
RPY55[1])	1 W	200 V	420 Ω	3.2 cm^2 (tot. area)	32	7.6	
RPY58[2])	200 mW[4])	50 V	600 Ω		6 × 2	6	
RPY71[2])	50 mW	50 V	3 to 6 kΩ[6])		5.3 × 1.3	5.3	





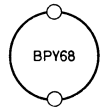
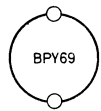
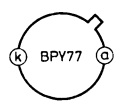
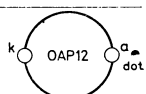


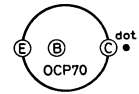
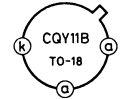


Type and application	*Light sensitivity* (nA/lx)	*Peak spectral response* (nm)	*Dark current* (μA)	*Reverse voltage* (V)	*Outlines* (mm)	*Base connections*
BPX25 Silicon planar epitaxial phototransistor	Characteristics: $I_B = 0$; $V_{CE} = 24$ V; at 1000 lx	800	< 1	$I_{CEO(L)} = 8$ mA	length < 6.9 width < 4.8 leads > 12.7	BPX25 TO-18
BPX29	For further data see BPX25			$I_{CEO(L)} = 0.8$ mA	length < 5.5 width < 4.8 leads > 12.7	BPX29 TO-18
BPX40 Silicon planar photo-diode	14	800	< 0.5	< 18	length 3.25 width 1.25 leads 30	a k 30 3.35 30 BPX40
BPX41 Silicon planar photo-diode	40	800	< 1	< 18	length 4.7 width 2.15 leads 30	a k 30 4.7 30 BPX41
BPX42 Silicon planar photo-diode	150	800	< 5	< 12	length 7.0 width 5.0 leads 30	a k 30 7.0 BPX42
BPX71 Photo transistor	P_{tot} = max. 50 mW at $t_{amb} = 50°C$	800	< 25 nA	50	length < 2.92 width < 1.58	C BPX71 E

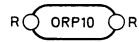
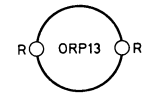
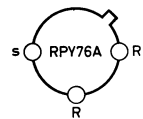
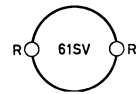
[1]) Top sensitivity. [2]) Side sensitivity. [3]) With a heatsink with $K = 5°C/W$. [4]) $T_{amb} = 40°C$. [5]) At 25.6 lux. [6]) At 10 lux.

PHOTOSENSITIVE DEVICES - Photo diodes and transistors

Type and application	*Light sensitivity (nA/lx)*	*Peak spectral response (nm)*	*Dark current (μA)*	*Reverse voltage (V)*	*Outlines (mm)*	*Base connections*
BPY10 Silicon photo-voltaic cell	16	800	< 5	< 1	length < 7.6 width < 2.2 leads > 37	
BPY68 Silicon duo photo-diode	500	980	< 50 nA	60	length < 9.4 width < 2.8 leads > 23	
BPY69 Silicon duo photo-diode	370	980	< 50 nA	60	length < 9.2 width < 2.2 leads > 23	
BPY76 Planar epitaxial photo-transistor	P_{tot} = max. 70 mW at t_{amb} = 25°C	800	< 100 nA	35	length < 4.5 width < 1.75 leads > 28	
BPY77 Silicon photo-diode	P_{tot} = max. 500 mW at t_{case} = 25°C	770	< 2 nA	100	length < 6.9 width < 4.8 leads > 12.7	
OAP12 Germanium photo-diode	50	1550	15	30	length < 9.4 width < 2.8 leads > 28	

OCP70 Germanium photo-transistor	>130 mA/lm (area 7 mm²)	1430	<325	7.5	length <15 width <6 leads >37	
CQY11B Gallium arsenide light emitting diode	Forward current (d.c.) Forward current (peak value) Radiation output power per unit current Rise time of output signal Emitted wavelength		I_F < 30 mA I_{FM} < 0,2 A P/I > 3 mW/A t_r = 30 ns λ = 875 nm		length <5.5 width <4.8 leads >12.7	

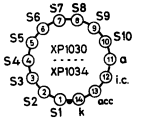
PHOTOSENSITIVE DEVICES - Infra-red devices

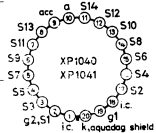
Type	*Spectral response range*	*Sensitive area*	*Max. current*	*Cell resistance*	*Max. temperature*	*Base connections*
ORP10	visible to 7.5 μm	3 mm²	100 mA at t_{amb} = 20°C	30–120 Ω	70°C	
ORP13	visible to 5.3 μm	3 mm²	30 mA at t_{amb} = 77 K	20–60 kΩ	77 K	
RPY76A	1.5–3.0 μm	1 mm²		600 kΩ	50°C	
61SV	0.3 to 3.5 μm	36 mm²	0.5 mA	1–4 MΩ	60°C	

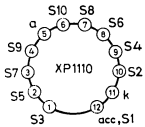
PHOTOSENSITIVE DEVICES - Photomultipliers

Type	*Spectral response*	*Useful diam.*	*N_a A/lumen or G(ain)*	*at V_b (V)*	*Dark curr. (μA)*	*at N_a A/lm or G(ain)*	*Max. length*	*Base connections*
10 stages								
XP1000	Super A	44	700	1800	0.015	100	148	
XP1001[1])	Super A	44	700	1800	0.015	100	148	
XP1002	T(S20)	44	400	1800	0.015	60	148	
XP1003	TU	44	400	1800	0.015	60	148	
XP1004	U(S13)	44	700	1800	0.015	100	148	
XP1005	C(S1)	44	100	1800	< 10	20	148	
XP1006[1])	D	44	250	1800	0.02	60	148	
10 stages								
XP1010[2])	Super A	32	700	1800	0.01	60	127	
XP1011[3])	Super A	32	700	1800	0.01	60	127	
XP1015[3])	A(S11)	32	700	1800	0.01	60	219	
XP1016[3])	T(S20)	32	400	1800	0.01	60	127	
12 stages								
XP1020	A(S11)	42	$G = 10^8$	2500	< 5	$G = 10^8$	197	
XP1021	A(S11)	42	$G = 10^6$	2500	< 5	$G = 10^9$	207	
XP1023	U(S13)	42	$G = 10^8$	2500	< 5	$G = 10^9$	207	

10 stages							
XP1030	A(S11)	63.5	250	1800	<0.2	100	159
XP1031[1]	A(S11)	63.5	250	1800	<0.2	100	159
XP1032	U(S13)	63.5	250	1800	<0.2	100	198
XP1033	U(S13)	63.5	250	1800	<0.2	100	205
XP1034[1]	D	63.5	250	1800	0.02	60	159
14 stages							
XP1040	A(S11)	110	$G=10^8$	2400	2	$G=10^8$	281
XP1041	D	110	$G=10^8$	2250	2	$G=10^8$	281
10 stages							
XP1110[3]	A(S11)	14	250	1800	0.02	30	105

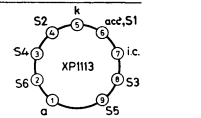
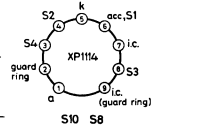
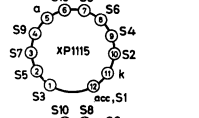
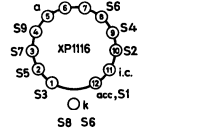
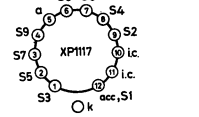




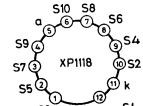


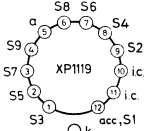
[1]) Energy resolution for $^{137}Cs(0.661\ MeV) = 8.5\%$. [2]) Low noise. [3]) Ruggedized.

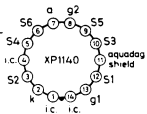
PHOTOSENSITIVE DEVICES - Photomultipliers

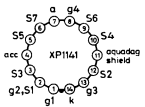
Type	*Spectral response*	*Useful diam.*	*N_a A/lumen or G(ain)*	*at V_b (V)*	*Dark curr. (μA)*	*at N_a A/lm or G(ain)*	*Max. length*	*Base connections*
6 stages **XP1113**	A(S11)	14	0.9	1200	0.01	0.3	70	
4 stages **XP1114**	A(S11)	14	20 mA/lm	900	<0.1 nA	4 mA/lm	70	
10 stages **XP1115**[3][4]	A(S11)	14	250	1800	0.02	30	105	
10 stages **XP1116**[3]	C(S1)	14	20	1800	<10	20	105	
9 stages **XP1117**[3]	T(S20)	14	100	1800	0.01	30	105	
10 stages **XP1118**	U(S13)	14	250	1800	0.02	30	105	
9 stages **XP1119**	D	14	100	1800	0.1	30	105	
6 stages **XP1140**	S4	150 mm²	$G=10^4$	3750	0.03	$G=10^4$	123	
7 stages **XP1141**	A(S11)	42	$G=10^4$	3500	0.1	$G=10^4$	167	
6 stages **XP1143**	S4	280 mm²	$G=10^4$	3500	1	$G=10^4$	160	

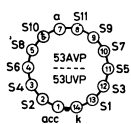
10 stages **XP1180**[1])	A(S11)	20	200	1800	5 nA	30	98
10 stages **XP1210**	A(S11)	42	$G = 10^7$	4000	< 1	$G = 10^7$	177
10 stages **XP1220**	A(S11)	13	$G = 10^7$	2100	< 1	$G = 10^7$	95
12 stages **XP1230**	D	42	$G = 10^8$	2100	0.2	$G = 10^8$	141
12 stages **XP2020**	D	42	$G = 10^8$	3000	0,027	$G = 10^8$	192
10 stages **XP2000**[5]) **XP2030**[5])	Super A Super A	44 69	$G = 2{,}5 \pm 10^5$ $G = 2{,}5 \pm 10^5$	1500 1500	5 nA 5 nA	$G = 2{,}5 \pm 10^5$ $G = 2{,}5 \pm 10^5$	148 159
11 stages **53AVP** **53DVP** **53UVP**	Super A D U(S13)	44 44 44	400 400 400	1800 1800 1800	0.015 0.05 0.015	60 60 60	153 153 153

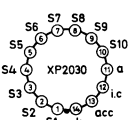


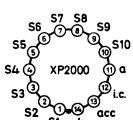


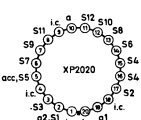


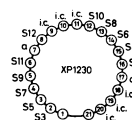


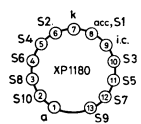




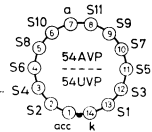
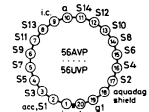
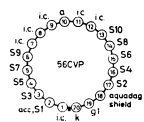
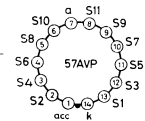




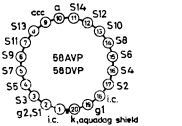


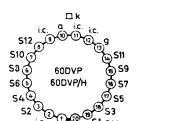


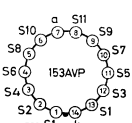
[1]) Energy resolution for $^{137}Cs(0.661\ MeV) = 11\,\%$. [3]) Ruggedized. [4]) With flying leads. [5]) Venetian blind photomultiplier

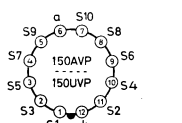
Type	*Spectral response*	*Useful diam.*	*N_a A/lumen or G(ain)*	*at V_b (V)*	*Dark curr. (μA)*	*at N_a A/lm or G(ain)*	*Max. length*	*Base connections*
11 stages								
54AVP	A(S11)	111	500	1800	0.2	250	235	
54DVP	D	111	500	1800	0.5	250	235	
54UVP	U(S13)	111	500	1800	0.2	250	235	
14 stages								
56AVP	A(S11)	42	$G=10^8$	2200	0.5	$G=10^8$	192	
56AVP/05	A/05	42	$G=10^8$	2200	0.5	$G=10^8$	192	
56DUVP	DU	42	$G=10^8$	2100	0.2	$G=10^8$	192	
56DUVP/03	DU	42	$G=10^8$	2100	0.2	$G=10^8$	192	
56DVP	D	42	$G=10^8$	2100	0.2	$G=10^8$	192	
56DVP/03	D	42	$G=10^8$	2100	0.2	$G=10^8$	192	
56SBUVP	SBU	42	$G=10^8$	2100	0.1	$G=10^8$	192	
56TUVP	TU	42	$G=10^8$	2500	<5	$G=10^8$	192	
56TVP	T(S20)	42	$G=10^8$	2500	<5	$G=10^8$	192	
56UVP	U(S13)	42	$G=10^8$	2200	0.5	$G=10^8$	192	
10 stages								
56CVP	C(S1)	42	100	2750	<10	20	174	
11 stages								
57AVP	A(S11)	200	250	1800	<1	60	328	

14 stages **58AVP**	A(S11)	110	$G = 10^8$	2400	2	$G = 10^8$	281
58DVP	D	110	$G = 10^8$	2250	2	$G = 10^8$	281
14 stages **58UVP**	U(S13)	110	$G = 10^8$	2400	2	$G = 10^8$	340
12 stages **60AVP**	A(S11)	200	$G = 10^8$	3000	< 20	$G = 10^8$	318
12 stages **60DVP** **60DVP/H**	D	200	$G = 10^8$	3000	0,5 nA	$G = 10^7$	318
10 stages **150AVP**	Super A	32	700	1800	0.01	60	127
150CVP	C(S1)	32	100	1800	< 10	20	127
150UVP	U(S13)	32	700	1800	0.01	60	127
11 stages **153AVP**[1])	A(S11)	44	400	1800	0.015	60	153





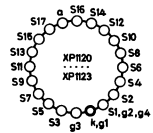


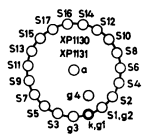


[1]) Energy resolution for $^{137}Cs(0.661\ MeV) = 8.5\%$.

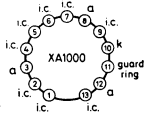
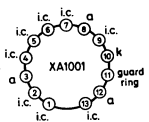
PHOTOSENSITIVE DEVICES - Windowless photomultipliers

Type[1])	*Cathode*[2]) *Dynode*	*Pressure (mm Hg)* *Quant. eff. UV*	*Gain at* $V_b = 4\ kV$	*Dark curr.* *at Gain* $= 10^6$	*Max. dimensions* *diam.*	*length*	*Base connections*
XP1120	Ni Cu-Be-O	10^{-5}–10^{-6} 10% at 80 nm	$5 \cdot 10^7$	10^{-10} A	60.5	325	
XP1121	Cu-Be-O Cu-Be-O	10^{-5}–10^{-6} 20% at 68 nm	$5 \cdot 10^7$	10^{-10} A	60.5	325	
XP1122	Ni Cu-Be-O	10^{-5}–10^{-6} 10% at 80 nm	$5 \cdot 10^7$	10^{-10} A	60.5	325	
XP1123	Cu-Be-O Cu-Be-O	10^{-5}–10^{-6} 20% at 68 nm	$5 \cdot 10^7$	10^{-10} A	60.5	325	
XP1130	Ni Cu-Be-O	10^{-5}–10^{-10} 10% at 80 nm	$5 \cdot 10^7$	10^{-10} A	90.5	321	
XP1131	Cu-Be-O Cu-Be-O	10^{-5}–10^{-10} 20% at 68 nm	$5 \cdot 10^7$	10^{-10} A	90.5	321	

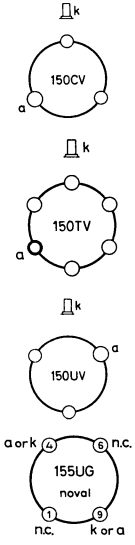




[1]) Potted voltage dividers; [2]) Minimum useful area $22 \times 22\ mm^2$.

Type	*Sensitivity* (*N*)	*Operating characteristics*	*Limiting values*	*Max. dimensions*		*Base connections*
				diam.	*height*	
AVHC41	50 μA/lm	V_a = 2.5 kV I_{ko} = 10 nA T_r = <0.4 ns	V_a = 2.5 kV I_{kp} = 50 A	57.2	46	
AVHC201	50 μA/lm	V_a = 2.5 kV I_{ko} = 10 nA T_r = <1 ns	V_a = 2.5 kV I_{kp} = 100 A	127.3	55.5	
TVHC40	150 μA/lm	V_a = 2.5 kV I_{ko} = 0.15 nA T_r = <0.4 ns	V_a = 5 kV I_{kp} = 50 A t_{amb} = 60°C	57.2	46	
XA1000[1])	60 μA/lm	V_a = 4.5 V I_{ko} = 1 pA T_r = <1 ns	V_a = 700 V I_{kp} = 2 mA t_{amb} = 60°C	28	29	
XA1001	60 μA/lm	V_a = 4.5 V I_{ko} = 1 pA T_r = <1 ns	V_a = 700 V I_{kp} = 2 mA t_{amb} = 70°C	28	29	
XA1002	30 μA/lm	V_a = 2.5 kV I_{ko} = 0.5 nA T_r = <0.25 ns	V_a = 4 kV I_{kp} = 10 A t_{amb} = 60°C	35	33	
XA1003	20 μA/lm	V_a = 2.5 kV I_{ko} = 5 nA T_r = <0.2 ns	V_a = 4 kV I_{kp} = 2 A t_{amb} = 60°C	35	33	

150CV	20 μA/lm	V_a = 6–90 $V_{d.c.}$ I_{kp} = 1 nA T_r = 14 ns	V_a = 100 $V_{d.c.}$ I_{kp} = 50 nA/mm^2 t_{bulb} = 60°C	52	82
150TV	150 μA/lm	V_a = 6–90 $V_{d.c.}$ I_{kp} = 1.5 pA T_r = 14 ns	V_a = 100 $V_{d.c.}$ I_{kp} = 50 nA/mm^2 t_{bulb} = 60°C	52	82
150UV	60 μA/lm	V_a = 6–90 $V_{d.c.}$ I_{kp} = 1 pA T_r = 14 ns	V_a = 100 $V_{d.c.}$ I_{kp} = 50 nA/mm^2 t_{bulb} = 60°C	52	110
155UG	Ultra-violet	V_m = 180–220 V Spectral response = 200–290 nm	t_{amb} = −25 to +70°C	30	35



[1]) Ruggedized

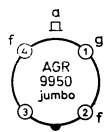
CHANNEL ELECTRON MULTIPLIERS

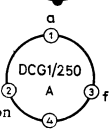
. . . . AL	with open-ended output
. . . . BL	with closed output
. . . . . ./01	are bakable versions

Type	*Description*	*Characteristics Gain*	*Resistance* (Ω)	*Max. operating voltage* (*kV*)
B310 . . series	Multipliers in the form a a glass planar spiral type	1.3×10^8	3×10^9	4.0
B312 . . series	Multipliers in the form of a glass planar spiral tube with a rectangular-section input cone 2 × 8 mm.	1.3×10^8	3×10^9	4.0
B318 . . series	Multipliers in the form of a glass planar spiral tube with a 5.0 mm diameter input cone.	1.3×10^8	3×10^9	4.0
B330 . . series	Multipliers in the form of a glass C-shaped tube	1.5×10^8	3×10^9	4.0
B410 . . series	Multipliers in the form of a glass planar spiral tube	1.5×10^8	3×10^8	3.5
B419 . . series	Multipliers in the form of a glass planar spiral tube with a 10 mm diameter input cone	1.7×10^8	3×10^9	3.5
G40-25	Multiplier in the form of a plate	> 1000	10^8	2.0
G40-50	Multiplier in the form of a plate	> 1000	10^7	2.0

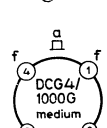
GAS-FILLED TUBES - High voltage rectifiers

Type and application	V_f (V) I_f (A)	*Circuit*	$V_{tr\ rms}$ (kV)	V_o (kV)	I_o (A)	W_o (kW)	*Limiting values*	*Accessories*	*Base*
AGR9950	5.0	1)	4.6	4.1	2	8.3	f = 150 Hz	Anode cap heat	
Grid-controlled	6.5	2)	5.3	6.2	3	18.6	V_{ainvp} = 13 kV	container: 40616	
mercury-vapour		3)	9.2	12.4	3	37.2	I_o = 1 A	Socket:	
rectifier							I_{ap} = 4 A	2422 511 02001	
DCG1/250	4.0	1)	1.06	0.95	0.5	0.48	f = 500 Hz	Socket:	
Mercury-vapour	2.5	2)	1.22	1.43	0.75	1.07	V_{ainvp} = 3 kV	2422 512 02001	
rectifier		3)	2.12	2.86	0.75	2.15	I_o = 0.25 A		
							I_{ap} = 1.25 A		
DCG4/1000ED	2.5	1)	3.5	3.3	0.5	1.59	f = 150 Hz	An. conn.: 40619	
Mercury-vapour	4.8	2)	4.1	4.8	0.75	3.6	V_{ainvp} = 10 kV	Socket: E300022	
rectifier		3)	7.1	9.6	0.75	7.2	I_o = 0.25 A		
							I_{ap} = 1 A		
DCG4/1000G		For further data see DCG4/1000ED						Socket: 2422 511 04001	

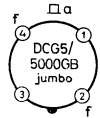


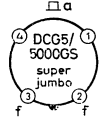


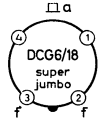
Edison

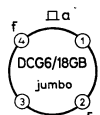


DCG4/5000	4.0	[1]	4.6	4.1	2.5	10.3	f = 150 Hz	An. conn.: 40619	Goliath
Mercury-vapour	7.0	[2]	5.3	6.2	3.75	23.3	V_{ainvp} = 13 kV	Socket:	
rectifier		[3]	9.2	12.4	3.75	46.6	I_o = 1.25 A	65909 BG/01	
							I_{ap} = 5 A		
DCG5/5000EG	5.0	[1]	4.75	4.3	3	12.9	f = 150 Hz	An. conn.: 40619	Goliath
Mercury-vapour	7.0	[2]	5.5	6.5	4.5	29	V_{ainvp} = 13 kV	Socket:	
rectifier		[3]	9.5	12.9	4.5	58	I_o = 1.5 A	65909BG/01	
							I_{ap} = 6 A		
DCG5/5000GB		For further data see DCG5/5000EG						Socket: 2422 511 02001	
DCG5/5000GS		For further data see DCG5/5000EG						Socket: 2422 511 01001	
DCG6/18	5.0	[1]	5.3	4.8	6	28.8	f = 150 Hz	An. conn.: 40619	
Mercury-vapour	11.5	[2]	6.1	7.2	9	65	V_{ainvp} = 15 kV	Socket:	
rectifier		[3]	10.6	14.4	9	130	I_o = 3 A	2422 511 01001	
							I_{ap} = 12 A		
DCG6/18GB		For further data see DCG6/18						Socket: 2422 511 02001	





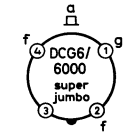


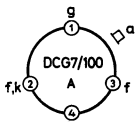


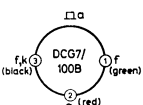
[1]) Two phase-half wave (2 tubes) [2]) Three phase-half wave (3 tubes) [3]) Three phase-full wave (6 tubes)

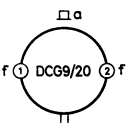
GAS-FILLED TUBES - High voltage rectifiers

Type and application	V_f (V) I_f (A)	*Circuit*	$V_{tr.rms}$ (kV)	V_o (kV)	I_o (A)	W_o (kW)	*Limiting values*	*Accessories*	*Base*
DCG6/6000	5.0	[1]	4.6	4.1	2	8.3	f = 150 Hz	Anode cap heat	
Grid controlled	6.5	[2]	5.3	6.2	3	18.6	V_{ainvp} = 13 kV	container: 40616	
mercury-vapour		[3]	9.2	12.4	3	37.2	I_o = 1 A	Socket:	
rectifier							I_{ap} = 4 A	2422 511 01001	
DCG7/100	5.0	[1]	5.3	4.8	20	96	f = 150 Hz	An. conn.: 40620	
Grid controlled	14	[2]	6.1	7.2	30	216	V_{ainvp} = 15 kV	Socket: 40409	
mercury-vapour		[3]	10.6	14.4	30	432	I_o = 10 A		
rectifier							I_{ap} = 45 A		
DCG7/100B		See DCG7/100 except for socket							
DCG9/20	5.0	[1]	7.4	6.7	5	33.5	f = 150 Hz	An. conn.: 40620	
Mercury-vapour	13.5	[2]	8.6	10	7.5	75	V_{ainvp} = 21 kV	An. cap heat	
rectifier		[3]	14.8	20	7.5	150	I_o = 2.5 A	container: 40616	
							I_{ap} = 10 A	Socket: 40209	

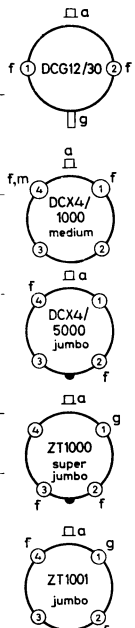






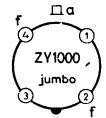
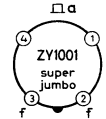


DCG12/30	5.0	[1]	9.5	8.6	5	43	f	= 150 Hz	An. conn.: 40620
Grid controlled	13.5	[2]	11	12.9	7.5	97	V_{ainvp}	= 27 kV	An. cap heat
mercury-vapour		[3]	19.1	25.8	7.5	194	I_o	= 2.5 A	container: 40616
rectifier							I_{ap}	= 10 A	Socket: 40209
DCX4/1000	2.5	[1]	3.5	3.2	0.5	1.6	f	= 150 Hz	An. conn.: 40619
Xenon-filled	5.0	[2]	4.1	4.8	0.75	3.6	V_{ainvp}	= 10 kV	Socket:
rectifier		[3]	7.1	9.6	0.75	7.2	I_o	= 0.25 A	2422 511 04001
							I_{ap}	= 1 A	
DCX4/5000	5.0	[1]	3.5	3.2	2.5	8	f	= 150 Hz	An. conn.: 40619
Xenon-filled	7.1	[2]	4.1	4.8	3.75	18	V_{ainvp}	= 10 kV	Socket:
rectifier		[3]	7.1	9.6	3.75	36	I_o	= 1.25 A	2422 511 02001
							I_{ap}	= 5 A	
ZT1000	5.0	[1]	7.4	6.7	5	33.5	f	= 150 Hz	An. conn. 40620
Grid controlled	13	[2]	8.5	10	7.5	75	V_{ainvp}	= 21 kV	An. cap heat
mercury-vapour		[3]	14.8	20	7.5	150	I_o	= 2.5 A	container: 40616
rectifier							I_{ap}	= 10 A	Socket:
									2422 511 01001
ZT1001	For further data see ZT1000								Socket:
									2422 511 02001

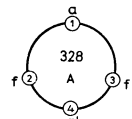


[1]) Two phase-half wave (2 tubes). [2]) Three phase-half wave (3 tubes). [3]) Three phase-full wave (6 tubes).

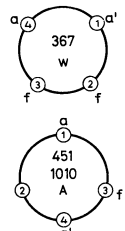
GAS-FILLED TUBES - High voltage rectifiers

Type and application	V_f (V) / I_f (A)	*Circuit*	$V_{tr.rms}$ (kV)	V_o (kV)	I_o (A)	W_o (kW)	*Limiting values*	*Accessories*	*Base*
ZY1000 Mercury-vapour rectifier	5.0 / 7.0	[1] [2] [3]	4.75 / 5.5 / 9.5	4.3 / 6.45 / 12.9	3 / 4.5 / 4.5	12.9 / 29 / 58	f = 150 Hz V_{ainvp} = 13.5 kV I_o = 1.5 A I_{ap} = 6 A	An. conn.: 40619 Socket: 2422 511 02001	
ZY1001		For further data see ZY1000						Socket: 2422 511 01001	
ZY1002		For further data see ZY1000						Socket: 65909BG/01	Goliath

GAS-FILLED TUBES - Low voltage rectifiers

Type	V_f (V) / I_f (A)	T_w (s)	*Typical characteristics*	*Limiting values*	*Max. dimensions* diam.	length	*Base*
328 Double anode rectifier	1.9 / 3.0	15	V_{arc} = 7 V V_{ign} = 16 V	V_{ainvp} = 90 V I_a = 0.65 A I_{ap} = 4.0 A R_t = min 3 Ω t_{amb} = −55 °C / +75 °C	33	112	

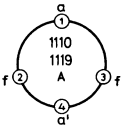
354 Single anode rectifier	1.9 5.5	30	V_{arc} = 8 V V_{ign} = 16 V	V_{ainvp} = 400 V I_a = 0.25 A I_{ap} = 1.25 A	R_t = min. 50 Ω t_{amb} = −55 °C / +75 °C	62	120	Edison
367 Double anode rectifier	1.9 8.0	30	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 140 V I_a = 3 A I_{ap} = 18 A	R_t = min. 1 Ω t_{amb} = −55 °C / +75 °C	81	170	
451 Double anode rectifier	1.9 2.8	15	V_{arc} = 7 V V_{ign} = 11 V	V_{ainvp} = 50 V I_a = 0.65 A I_{ap} = 4.0 A	R_t = min. 3 Ω t_{Hg} = 30–75 °C	33	112	
1010 Double anode rectifier	1.9 3.5	15	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 185 V I_a = 0.65 A I_{ap} = 4.0 A	R_t = min. 10 Ω t_{amb} = −55 °C / +75 °C	37	120	
1037 Double anode rectifier	1.9 11	120	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 185 V I_a = 3.0 A I_{ap} = 18 A	R_t = min. 1.75 Ω t_{Hg} = 30–80 °C	85	240	Goliath
1039 Double anode rectifier	1.9 20	120	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 185 V I_a = 7.5 A I_{ap} = 45 A	R_t = min. 075 Ω t_{Hg} = 30–80 °C	94	264	Goliath
1049 Double anode rectifier	1.9 28.5	120	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 185 V I_a = 12.5 A I_{ap} = 75 A	R_t = min. 0.3 Ω t_{Hg} = 30–80 °C	101	280	Straps
1054 Double anode rectifier	1.9 68	120	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 150 V I_a = 20 A I_{ap} = 120 A	R_t = min. 0.18 Ω t_{Hg} = 30–80 °C	111	350	Straps



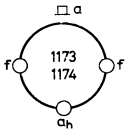
[1]) Two phase-half wave (2 tubes). [2]) Three phase-half wave (3 tubes). [3]) Three phase-full wave (6 tubes).

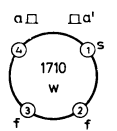
GAS-FILLED TUBES - Low voltage rectifiers

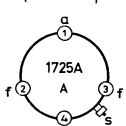
Type	V_f (V) I_f (A)	T_w (s)	*Typical characteristics*	*Limiting values*		*Max. dimensions* *diam.*	 *length*	*Base*
1069K Double anode rectifier	3.25 70	120	V_{arc} = 10 V V_{ign} = 16 V	V_{ainvp} = 170 V I_a = 30 A I_{ap} = 200 A	R_t = min. 0.12 Ω t_{Hg} = 30–75 °C	114	365	Straps
1110 Double anode rectifier	1.9 3.5	15	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 185 V I_a = 0.85 A I_{ap} = 5.0 A	R_t = min. 4 Ω t_{amb} = −55 °C +75 °C	39	131	
1119 Double anode rectifier	1.9 5.8	30	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 140 V I_a = 1.5 A I_{ap} = 9.0 A	R_t = min. 1.8 Ω t_{amb} = −55 °C +75 °C	71	142	
1138 Single anode rectifier	2.5 27	120	V_{arc} = 10 V V_{ign} = 16 V	V_{ainvp} = 275 V I_a = 15 A I_{ap} = 85 A	R_t = min. 0.3 Ω t_{Hg} = 30–80 °C	115	269	Goliath
1163 Single anode rectifier	2.25 17	3	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 375 V I_a = 6 A I_{ap} = 36 A	R_t = min. 0.5 Ω t_{amb} = −55 °C +75 °C	83	178	Goliath
1164 Single anode rectifier	2.5 25	15	V_{arc} = 9 V V_{ign} = 16 V	V_{ainvp} = 225 V I_a = 15 A I_{ap} = 90 A	R_t = min. 0.3 Ω t_{amb} = −55 °C +75 °C	98	220	Goliath



1173 Single anode rectifier	1.9 13	60	$V_{arc} = 12$ V $V_{ign} = 22$ V	$V_{ainvp} = 850$ V $I_a = 4$ A $I_{ap} = 20$ A	$R_t =$ min. 0.75 Ω $t_{Hg} = 30$–75 °C	62	189	
1174 Single anode rectifier	1.9 12	60	$V_{arc} = 12$ V $V_{ign} = 22$ V	$V_{ainvp} = 850$ V $I_a = 6$ A $I_{ap} = 30$ A	$R_t =$ min. 0.5 Ω $t_{Hg} = 30$–75 °C	77	218	
1176 Single anode rectifier	1.9 28	120	$V_{arc} = 12$ V $V_{ign} = 22$ V	$V_{ainvp} = 850$ V $I_a = 15$ A $I_{ap} = 75$ A	$R_t =$ min. 0.2 Ω $t_{Hg} = 30$–75 °C	92	301	Straps
1177 Single anode rectifier	1.9 60	120	$V_{arc} = 12$ V $V_{ign} = 28$ V	$V_{ainvp} = 850$ V $I_a = 25$ A $I_{ap} = 135$ A	$R_t =$ min. 0.1 Ω $t_{Hg} = 30$–75 °C	128	362	Straps
1710 Double anode rectifier	1.9 8.0	30	$V_{arc} = 10$ V $V_{ign} = 22$ V	$V_{ainvp} = 470$ V $I_a = 1.5$ A $I_{ap} = 9.0$ A	$R_t =$ min. 2.5 Ω $t_{Hg} = 30$–80 °C	69.5	205	
1725A Double anode rectifier	1.9 3.5	15	$V_{arc} = 10$ V $V_{ign} = 22$ V	$V_{ainvp} = 470$ V $I_a = 0.65$ A $I_{ap} = 4.0$ A	$R_t =$ min. 5 Ω $t_{amb} = -55$ °C $+75$ °C	71	135	
1738 Double anode rectifier	1.9 18	120	$V_{arc} = 9$ V $V_{ign} = 20$ V	$V_{ainvp} = 300$ V $I_a = 7.5$ A $I_{ap} = 45$ A	$R_t =$ min. 0.2 Ω $t_{Hg} = 30$–80 °C	94	284	Goliath

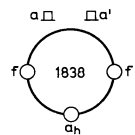




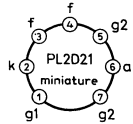
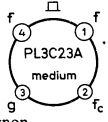
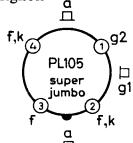
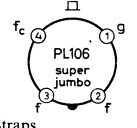


GAS-FILLED TUBES - Low voltage rectifiers

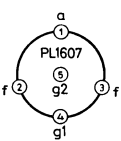
Type	V_f (V) I_f (A)	T_w (s)	*Typical characteristics*	*Limiting values*		*Max. dimensions* diam.	length	*Base connections*
1749A Double anode rectifier	1.9 25	120	V_{arc} = 10 V V_{ign} = 22 V	V_{ainvp} = 300 V I_a = 12.5 A I_{ap} = 75 A	R_t = min. 0.1 Ω t_{Hg} = 30–80 °C	101	290	Straps
1788 Double anode rectifier	1.9 11	120	V_{arc} = 9 V V_{ign} = 22 V	V_{ainvp} = 300 V I_a = 5 A I_{ap} = 30 A	R_t = min. 0.3 Ω t_{Hg} = 30–80 °C	94	284	Goliath
1838 Double anode rectifier	1.9 21.5	120	V_{arc} = 10 V V_{ign} = 22 V	V_{ainvp} = 360 V I_a = 7.5 A I_{ap} = 45 A	R_t = min. 0.25 Ω t_{Hg} = 30–80 °C	97	262	
1849 Double anode rectifier	1.9 29	120	V_{arc} = 10 V V_{ign} = 22 V	V_{ainvp} = 360 V I_a = 12.5 A I_{ap} = 75 A	R_t = min. 0.2 Ω t_{Hg} = 30–80 °C	105	294	Straps
1859 Double anode rectifier	1.9 60	120	V_{arc} = 12 V V_{ign} = 28 V	V_{ainvp} = 360 V I_a = 25 A I_{ap} = 150 A	R_t = min. 0.1 Ω t_{Hg} = 30–80 °C	143	436	Straps

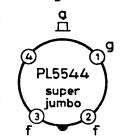


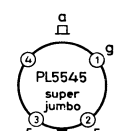
GAS-FILLED TUBES - Thyratrons

PL2D21 Tetrode	6.3 0.6	20	V_{arc} = 8 V T_{ion} = 0.5 μs T_{dion} = 35 μs	V_{ap} = 650 V V_{ainp} = 1.3 kV I_k = 0.1 A	I_{kp} = 0.5 A t_{amb} = −75°C +90°C	19	54	
PL3C23A Triode	2.5 7.0	>15	V_{arc} = 10 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 1.5 kV V_{ainvp} = 1.5 kV I_k = 1.6 A I_{kp} = 6.4 A	I_g = 10 mA I_{gp} = 50 mA −40°C t_{Hg} = +80°C	52	155	
PL10 Triode	1.85 3.4	0	V_{arc} = 20–35 V at I_a = 0.1–0.4 A	V_{ap} = 400 V V_{ainvp} = 400 V I_a = 100 mA	I_{ap} = 4 A t_{amb} = −75°C +90°C	21.5	105	Mignon
PL105 Tetrode	5.0 10	>300	V_{arc} = 12 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 2.5 kV V_{ainvp} = 2.5 kV I_a = 6.4 A	I_{ap} = 40 A t_{Hg} = 40–80°C	123	288	
PL106 Triode	2.5 22	60	V_{arc} = 12 V T_{ion} = 10 μs T_{dion} = 500 μs	V_{ap} = 2 kV V_{ainvp} = 2 kV I_k = 6.4 A	I_{kp} = 80 A t_{Hg} = 25–80°C	73	290	
PL150 Triode	1.9 26	>60	V_{arc} = 12 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 120 V V_{ainvp} = 250 V I_a = 17 A	I_{ap} = 65 A t_{Hg} = 40–80°C	92	293	Straps
PL255 Triode	5.0 11	>600	V_{arc} = 10 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 1.5 kV V_{ainvp} = 2.5 kV I_k = 10 A	I_{kp} = 100 A t_{Hg} = 35–75°C	102	334	Straps

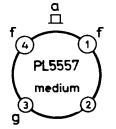
GAS-FILLED TUBES - Thyratrons

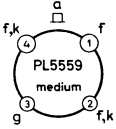
Type	V_f (V) I_f (A)	T_w (s)	*Typical characteristics*	*Limiting values*		*Max. dimensions* *diam.*	 *length*	*Base connections*
PL260 Triode	5.0 19	>600	V_{arc} = 10 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 2.0 kV V_{ainvp} = 2.5 kV I_k = 60 A	I_{kp} = 200 A t_{Hg} = 40–80°C	127	405	Straps
PL1607 Tetrode	2.0 2.6	>30	V_{arc} = 15 V T_{dion} = 500 μs	V_{ap} = 650 V V_{ainvp} = 650 V I_a = 0.5 A	I_{ap} = 2 A t_{amb} = −75°C +90°C	48	142	
PL5544 Triode	2.5 12	>60	V_{arc} = 12 V T_{ion} = 10 μs T_{dion} = 400 μs	V_{ap} = 1.5 kV V_{ainvp} = 1.5 kV I_k = 3.2 A	I_{kp} = 40 A t_{amb} = −55°C +70°C	67	190	
PL5545 Triode	2.5 21	>60	V_{arc} = 12 V T_{ion} = 10 μs T_{dion} = 500 μs	V_{ap} = 1.5 kV V_{ainvp} = 1.5 kV I_k = 6.4 A	I_{kp} = 80 A t_{amb} = −55°C +70°C	67	229	

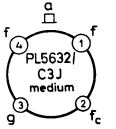


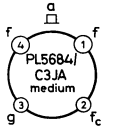


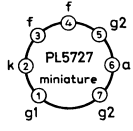
PL5557 Triode	2.5 5.0	10	V_{arc} = 12 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 2.5 kV V_{ainvp} = 5.0 kV I_a = 0.5 A	I_{ap} = 2 A t_{Hg} = 35–80 °C	52	155
PL5559 Triode	5.0 4.5	>300	V_{arc} = 12 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 1 kV V_{ainvp} = 1 kV I_k = 2.5 A	I_{kp} = 15 A t_{Hg} = 40–80 °C	76	185
PL5632/ **C3J** Triode	2.5 9.0	60	V_{arc} = 10 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 900 V V_{ainvp} = 1.25 kV I_k = 2.5 A	I_{kp} = 30 A t_{amb} = −55 °C +75 °C	40	150
PL5684/ **C3JA** Triode	2.5 9.0	60	V_{arc} = 10 V T_{ion} = 10 μs T_{dion} = 1000 μs	V_{ap} = 1 kV V_{ainvp} = 1.25 kV I_k = 2.5 A	I_{kp} = 30 A t_{amb} = −55 °C +75 °C	40	150
PL5727 Tetrode	6.3 0.6	20	V_{arc} = 8 V T_{ion} = 0.5 μs T_{dion} = 75 μs	V_{ap} = 650 V V_{ainvp} = 1.3 kV I_k = 0.1 A	I_{kp} = 0.5 A t_{amb} = −75 °C t_{bulb} = +150 °C	19	54



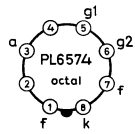
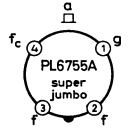
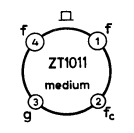
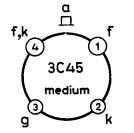


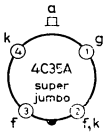
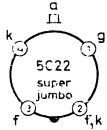
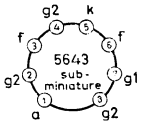
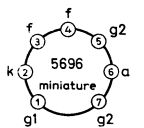
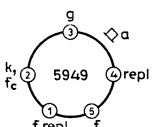




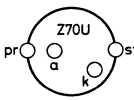
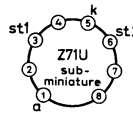
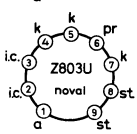
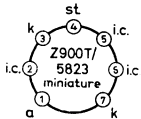
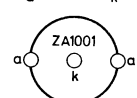


GAS-FILLED TUBES - Thyratrons

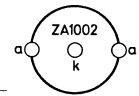
Type	V_f (V) / I_f (A)	T_w (s)	*Typical characteristics*	*Limiting values*		*Max. dimensions* diam.	length	*Base connections*
PL6574 Tetrode	6.3 0.95	>15	V_{arc} = 10 V V_a/V_{g1} = 275 V_a/V_{g2} = 370	V_{ap} = 650 V V_{ainvp} = 1.3 kV I_k = 0.3 A	I_{kp} = 2 A t_{amb} = −75 °C to +90 °C	33	70	
PL6755A Triode	2.5 11	>30	V_{arc} = 12 V T_{ion} = 10 μs T_{dion} = 500 μs	V_{ap} = 2 kV V_{ainvp} = 2 kV I_k = 3.6 A	I_{kp} = 40 A t_{amb} = 0–55 °C	59	228	
ZT1011 Triode	2.5 8.5	>10	V_{arc} = 10 V T_{dion} = 200–300 μs I_g = <20 μA	V_{ap} = 1.5 kV V_{ainvp} = 1.5 kV I_k = 2.5 A	I_{kp} = 30 A t_{amb} = −55 °C to +75 °C	40	120	
3C45 Hydrogen triode	6.3 2.25	>120	Oper. factor $V_{ap} \cdot I_{ap} \cdot f_{imp}$ = max. 0.3 × 10⁹ VAHz	V_{ap} = 3 kV V_{ainvp} = 3 kV I_a = 45 mA	I_{ap} = 35 A t_{amb} = −50 °C to +90 °C	40	132	

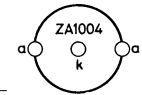
4C35A Hydrogen triode	6.3 6.1	>180	Oper. factor $V_{ap} \cdot I_{ap} \cdot f_{imp} =$ max. 2×10^9 VAHz	V_{ap} = 8 kV V_{ainvp} = 8 kV I_a = 100 mA	I_{ap} = 90 A t_{amb} = −50 °C +90 °C	65	174	
5C22 Hydrogen triode	6.3 10.6	>300	Oper. factor = $V_{ap} \cdot I_{ap} \cdot f_{imp} =$ max. 3.2×10^9 VAHz	V_{ap} = 16 kV V_{ainvp} = 16 kV I_a = 200 mA	I_{ap} = 325 A t_{amb} = −50 °C +90 °C	65	222	
5643 Tetrode	6.3 0.15	10	V_{arc} = 10 V I_a = 20 mA	V_{ap} = 500 V V_{ainvp} = 500 V I_k = 22 mA	I_{kp} = 100 mA t_{amb} = −55 °C +100 °C	10.16	34.9	
5696 Tetrode	6.3 0.15	10	V_{arc} = 10 V T_{dion} = 40 µs	V_{ap} = 500 V V_{ainvp} = 500 V I_k = 25 mA	I_{kp} = 100 mA t_{amb} = −55 °C +90 °C	19	44.5	
5949 Hydrogen triode	6.3 18.5	>900	Oper. factor $V_{ap} \cdot I_{ap} \cdot f_{imp} =$ max. 6.25×10^9 VAHz	V_{ap} = 25 kV V_{ainvp} = 25 kV I_a = 0.5 A	I_{ap} = 500 A t_{amb} = −55 °C +75 °C	84	317	
								

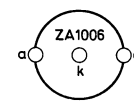
GAS-FILLED TUBES - Trigger tubes and switching diodes

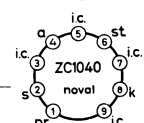
Type	*Characteristics*		*Limiting values*	*Max. dimensions*		*Base connections*
				diam.	*length*	
Z70U Trigger tube	V_{ba} = 250 V V_m = 116 V I_k = 5 mA	$V_{st\,ign}$ = 145 V C_{st} = min. 100 pF	V_{ba} = 310 V I_{kp} = 200 mA t_{bulb} = −55 °C +100 °C	10.16	23.5	
Z71U Trigger tube	V_{ba} = 150 V V_m = 60 V I_k = 7 mA	$V_{st\,ign}$ = 80 V I_{st} = 40 μA	V_{ba} = 170 V I_{kp} = 12 mA t_{bulb} = −50 °C +70 °C	10.16	45	
Z803U Trigger tube	V_{ba} = 240 V V_m = 105 V I_k = 40 mA	$V_{st\,ign}$ = 132 V C_{st} = 500 pF I_{st} = 45 μA	V_{ba} = 290 V I_{kp} = 200 mA $V_{a\,st}$ = 290 V $-V_{a\,st}$ = 140 V	22	45	
Z900T/ **5823** Trigger tube	V_{ba} = 117 $V_{a.c.}$ 175 $V_{d.c.}$ V_m = 62 V I_k = 15 mA	$V_{st\,ign}$ = 80 V C_{st} = min. 400 pF	V_{ba} = 200 V I_{kp} = 150 mA	19	54	
ZA1001 Switching diode	V_{ign} = 128 V V_m = 93 V	I_k = 1.5 mA r_{ins} = min. 300 MΩ	$-V_{ap}$ = 100 V t_{bulb} = −55 °C +70 °C	6.5	25	

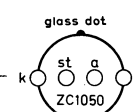
ZA1002 Switching and light diode	$V_{ign} = 170$ V $V_m = 109$ V	$I_k = 3.5$ mA $r_{ins} =$ min. 300 MΩ	$-V_{ap} = 200$ V $I_{kp} = 50$ mA $t_{bulb} = \begin{matrix}-55°C \\ +70°C\end{matrix}$	6.5	25
ZA1004 Indicator diode	$V_{ign} = 90$ V $V_{ext} =$ min. 83.5 V $I_k = 1$ mA	$E = 60$ lux $r_{ins} =$ min. 300 MΩ	$-V_{ap} = 70$ V $I_{kp} = 3$ mA $t_{bulb} = \begin{matrix}-55°C \\ +70°C\end{matrix}$	6.5	25
ZA1006 Switching and light diode	$V_{ign} = 172$ V $V_m = 107$ V	$I_k = 3$ mA $r_{ins} =$ min. 300 MΩ	$-V_{ap} = 200$ V $t_{bulb} = \begin{matrix}-55°C \\ +70°C\end{matrix}$	6.5	25
ZC1040 Trigger tube	$V_{ba} = 220$ $V_{a.c.}$ 300 $V_{d.c.}$ $V_m = 112$ V	$V_{st\,ign} = 130$ V $C_{st} =$ min. 200 pF $I_{st} = 200$ μA	$V_a = 250$ $V_{a.c.}$ $I_k = 40$ mA $I_{kp} = 200$ mA $t_{bulb} = \begin{matrix}-55°C \\ +75°C\end{matrix}$	22	55.6
ZC1050 Trigger tube	$V_{ba} = 300$ V $V_m = 133$ V $I_k = 2$ mA	$V_{st\,ign} = 200$ V $C_{st} =$ min. 1.5 nF	$-V_a = 100$ V $-V_{st} = 100$ V $I_{kp} = 10$ mA $t_{bulb} = \begin{matrix}-55°C \\ +70°C\end{matrix}$	6.5	31



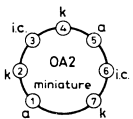
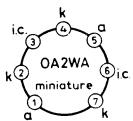
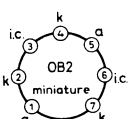
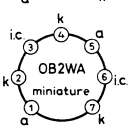




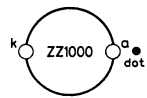
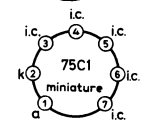
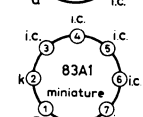
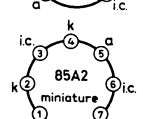


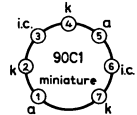
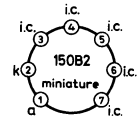
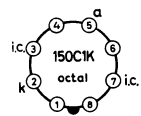


GAS-FILLED TUBES - Stabilizing and reference tubes

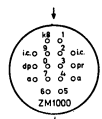
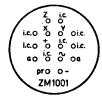
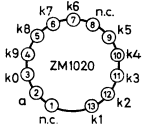
Type	*Characteristics and range values*	*Limiting values*	*Max. dimensions*		*Base connections*
			diam.	*length*	
OA2 Voltage stabilizing tube	V_{ign} = max. 180 V V_m (I_k = 5–30 mA) = 144–160 V V_r = max. 6 V r_a (I_k = 20 mA) = 80 Ω t_{amb} = 25 °C	I_{kp} = 75 mA $-V_{ap}$ = 125 V t_{amb} = −55 °C to +90 °C	19	66.7	
OA2WA Voltage Stabilizing tube	V_{ign} = max. 165 V V_m (I_k = 5–30 mA) = 144–153 V V_r (I_k = 5–30 mA) = max. 5 V r_a (I_k = 20 mA) = 80 Ω t_{amb} = 25 °C	I_{kp} = 75 mA $-V_{ap}$ = 125 V t_{amb} = − 55 °C t_{bulb} = + 150 °C	19	66.7	
OB2 Voltage stabilizing tube	V_{ign} = max. 127 V V_m (I_k = 17.5 mA) = 106–111 V V_r (I_k = 5–30 mA) = max. 3.5 V r_a (I_k = 20 mA) = 80 Ω t_{amb} = 25 °C	I_{kp} = 75 mA $-V_{ap}$ = 75 V t_{amb} = −55 °C to +90 °C	19	66.7	
OB2WA Voltage stabilizing tube	V_{ign} = max. 130 V V_m (I_k = 5–30 mA) = 105–111 V V_r (I_k = 5–30 mA) = max. 2.5 V r_a (I_k = 20 mA) = 80 Ω t_{amb} = 25 °C	I_{kp} = 75 mA $-V_{ap}$ = 75 V t_{amb} = −55 °C t_{bulb} = + 150 °C	19	66.7	

GAS-FILLED TUBES - Stabilizing and reference tubes

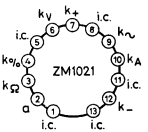
Type	*Characteristics and range values*	*Limiting values*	*Max. dimensions*		*Base connections*
			diam.	*length*	
ZZ1000 Voltage reference tube	V_{ign} = max. 115 V V_m (I_k = 3.2 mA) = 80.1–82.5 V r_a = 200 Ω	I_{kp} = 20 mA $-V_{ap}$ = 100 V t_{bulb} = −55 °C to +125 °C	6.5	30	
75C1 Voltage stabilizing tube	V_{ign} = max. 115 V V_m (I_k = 30 mA) = 75–81 V V_r (I_k = 2–60 mA) = max. 8 V r_a = 130 Ω	I_{kp} = 100 mA $-V_{ap}$ = 50 V t_{bulb} = −55 °C to +140 °C	19	54.5	
83A1 Voltage reference tube	V_{ign} = max. 120 V V_m (I_k = 4.5 mA) = 83–84.5 V r_a = 250 Ω	I_{kp} = 10 mA $-V_{ap}$ = 50 V t_{bulb} = −55 °C to +150 °C	19	54	
85A2 Voltage reference tube	V_{ign} = max. 115 V V_m (I_k = 5.5 mA) = 83–87 V r_a = 300 Ω	I_{kp} = 40 mA $-V_{ap}$ = 75 V t_{bulb} = −55 °C to +90 °C	19	54	

90C1 Voltage stabilizing tube	V_{ign} = max. 115 V V_m (I_k = 20 mA) = 86–94 V V_r (I_k = 1–40 mA) max. 14 V r_a (I_k = 20 mA) = 300 Ω	I_{kp} = 100 mA $-V_{ap}$ = 75 V t_{bulb} = -55 °C $+110$ °C	19	54	
150B2 Voltage stabilizing tube	V_{ign} = max. 180 V V_m (I_k = 10 mA) = 146–154 V V_r (I_k = 5–15 mA) = max. 5 V r_a (I_k = 10 mA) = 350 Ω	I_{kp} = 40 mA $-V_{ap}$ = 130 V t_{bulb} = -55 °C $+110$ °C	19	54	
150C1K Voltage stabilizing tube	V_{ign} = max. 205 V V_m (I_k = 20 mA) = 144–164 V V_r (I_k = 5–40 mA) = max. 8 V	I_{kp} = 75 mA	43	114	

GAS-FILLED TUBES - Indicating tubes

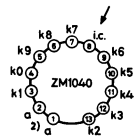
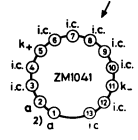
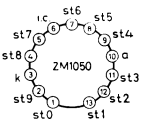
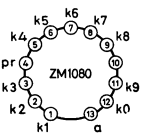
Type		*Characteristics*	*Limiting values*	*Base connections*
ZM1000 **ZM1000R** [1]	Numerals 0–9 Numeral height 14 mm Side viewing	V_{ign} = max. 170 V V_m = 140 V I_a = min. 1.5 mA I_a ≈ max. 4.5 mA V_{ext} = min. 118 V	I_{ap} = 12 mA t_{amb} = −50°C to +70°C	
ZM1001 **ZM1001R** [1]	Characters +, −, ~, x, y, z Character height 10–14 mm	For further data see ZM1000		
ZM1002	Characters ns, µs, ms, s, Hz, kHz, MHz Character height 9–13 mm	For further data see ZM 1000		
ZM1005 **ZM1005R** [1]	Numerals 0–9 Numeral height 14 mm Side viewing	V_{ign} = max. 170 V V_m = 140 V I_a = max. 2.5 mA $V_{ext.}$ = min. 118 V	I_{ap} = 20 mA t_{amb} = −50°C to +70°C	
ZM1020 [1]	Numerals 0–9 Numeral height 15.5 mm Top viewing	V_{ign} = max. 170 V V_m = 140 V I_a min. = 1 mA I_a max. = 3 mA $V_{ext.}$ = min. 118 V	I_{ap} = 10 mA t_{amb} = −50°C to +70°C	
ZM1021	Characters A, V, Ω, %, ~, +, −.	For further data see ZM1020		
ZM1022	The ZM1022 is electrically identical with type ZM1020 but has no filter coating			

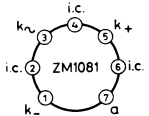
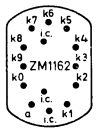
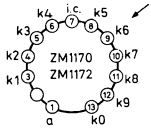
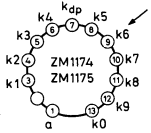
ZM1023	The ZM1023 is electrically identical with type ZM1021 but has no filter coating		
ZM1024	Characters c/s, Kc/s, Mc/s, μs, ms, ns, s For further data see ZM1020		
ZM1025	The ZM1025 is electrically identical with type ZM1024 but has no filter coating		
ZM1030[1])	Numerals 0–9 Numeral height 15.5 mm Side viewing	V_{ign} = max. 170 V V_m = 140 V I_a min. 3 mA I_a max. 5 mA $V_{ext.}$ = min. 110 V	I_{ap} = 12 mA t_{bulb} = −55°C … +70°C
ZM1031/01[1])	Signs +, −, ~. Sign height 15 mm Side viewing	V_{ign} = max. 170 V V_m = 140 V I_a = min. 2 mA I_a = max. 4 mA r_a = 4.5 kΩ	I_{ap} = 10 mA t_{bulb} = −55°C … +70°C
ZM1032	Signs 0–9 The ZM1032 is electrically identical with type ZM1030 but has no filter coating		
ZM1033/01	The ZM1033/01 is electrically identical with type ZM1031/01 but has no filter coating		



[1]) Provided with a red contrast filter.

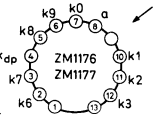
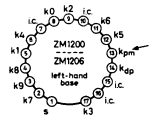
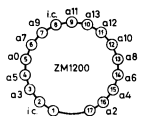
GAS-FILLED TUBES - Indicating tubes

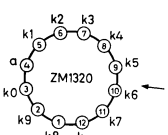
Type		*Characteristics*	*Limiting values*	*Base connections*
ZM1040[1])	Numerals 0–9 Numeral height 30 mm Side viewing	V_{ign} = max. 170 V V_m = 140 V I_k = min. 3 mA I_k = max. 6 mA $V_{ext.}$ = min. 120 V	I_{kp} = 20 mA t_{bulb} = 0 °C to +70 °C	
ZM1041[1])	Signs +, −. Sign height 20 mm Side viewing	V_{ign} = max. 170 V V_m = 140 V I_k = min. 3 mA I_k = max. 6 mA $V_{ext.}$ = min. 120 V	I_{kp} = 20 mA t_{bulb} = −50 °C to +70 °C	
ZM1042	The ZM1042 is electrically identical with type ZM1040 but has no filter coating			
ZM1043	The ZM1043 is electrically identical with type ZM1041 but has no filter coating			
ZM1050	Numerals 0–9 Numeral height 3 mm Top viewing	V_{tr} = 110 V_{rms} R_k = 10 kΩ R_{st} = 330 kΩ C_k = 33 nF I_{st} = 50 μA V_m = 84 V I_k = 3 mA	V_{tr} = 150 V_{rms} I_k = 4 mA R_{st} = min. 0.1 MΩ to max. 0.47 MΩ t_{bulb} = −55 °C to +70 °C	
ZM1080[1])	Numerals 0–9 Numeral height 13 mm Side viewing	V_b = min. 170 V V_m = 140 V I_k = min. 1.5 mA I_k = max. 3.5 mA	I_{kp} = 12 mA t_{bulb} = −50 °C to +70 °C	

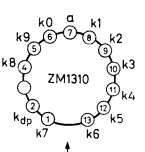
ZM1081[1])	Characters −, +, ∼. Character height 10.5 mm Side viewing	V_b = min. 170 V V_m = 140 V I_k = min. 1.5 mA I_k = max. 3.5 mA	I_{kp} = 12 mA t_{bulb} = −50°C … +70°C	
ZM1082	The ZM1082 is electrically identical with type ZM1080 but has no filter coating			
ZM1083	The ZM1083 is electrically identical with type ZM1081 but has no filter coating			
ZM1162	Numerals 0–9 Numeral height 15.5 mm Topviewing	V_{ign} = min. 170 V V_m = 150–170 V I_k = 2.5 mA	I_{kp} = 3.5 mA t_{bulb} = −10°C … +70°C	
ZM1170	Numerals 0–9 Numeral height 15.5 mm Side viewing	V_{ign} = min. 170 V V_m = 135–160 V I_k = 2.5 mA	I_{kp} = 12 mA t_{bulb} = −50°C … +70°C	
ZM1172	The ZM1172 is electrically identical with type ZM1170 but has no filter coating			
ZM1174 to **ZM1177**	Numerals 0–9 Numeral height 15,5 mm Side viewing	V_{ign} = max. 170 V V_m = 135–160 V I_k = 2.5 mA	I_{kp} = 12 mA t_{bulb} = −50°C … +70°C	
ZM1174 **ZM1175** **ZM1176** **ZM1177**	Decimal point on the left hand side. Red contrast filter Decimal point on the left hand side. No filter Decimal point on the right hand side. Red contrast filter Decimal point on the right hand side. No filter			

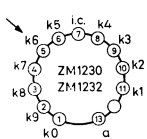
[1]) Provided with a red contrast filter. [2]) Pins 1 and 2 to be interconnected externally.

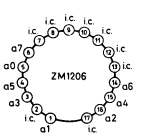
GAS-FILLED TUBES - Indicating tubes

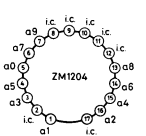
Type		*Characteristics*	*Limiting values*	*Base connections*
ZM1200 **ZM1202** **ZM1204** **ZM1206** pandicon	Numerals 0–9 Numeral height 10 mm Side viewing	V_{ign} = max. 170 V V_m = 160 V	$I_{a\_}$ = 12 mA t_{amb} = −50°C … +70°C	
ZM1230 **ZM1232**	Numerals 0–9 Numeral height 15,5 mm Side viewing	V_{ign} = min. 170 V V_m = 135–160 V I_k = 2.5 mA	I_{kp} = 12 mA t_{bulb} = −50°C … +70°C	
ZM1310	Numerals 0–9 Numeral height 12,5 mm side viewing	V_{ign} = max. 190 V V_m = 160 V I_k = 0,5 mA	I_{kp} = 8 mA t_{amb} = 0°C … +50°C	
ZM1320	Numerals 0–9 numeral height 12,5 mm Side viewing	V_{ign} = max. 170 V V_m = 160 V I_k = 1.7 mA	I_{kp} = 19 mA t_{amb} = 0°C … +50°C	

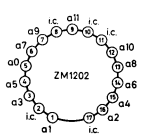


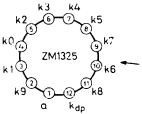
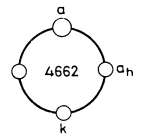




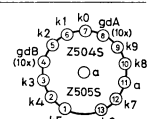






ZM1325	Numerals 0–9 Numeral height 9.5 mm Side viewing	V_{ign} = max. 170 V V_m = 135–160 V I_k = 1,1 mA	I_{kp} = 11 mA t_{amb} = 0°C = + 50°C	
4662	Neon light bar Side viewing	V_{ign} = 165–190 V I_{ah} = 40–50 μA V_m = 150–170 V	I_a = 2 mA	

GAS-FILLED TUBES - Counter and selector tubes

Type	*Characteristics and operating conditions*		*Base connections*
Z504S Counter and selector tube	Max. counting speed = 5 kHz Supply voltage = 475 V Output current = 340 μA Output voltage = 35 V	Anode supply voltage = 375–1000 V Time constant rise of anode supply voltage when switching on V_{ba} < 550 V = 1.0 ms V_{ba} > 550 V = 6.0 ms	
Z505S Selector tube	Max. counting speed = 50 kHz Supply voltage = 500 V Output current = 800 μA Output voltage = 24 V	Anode supply voltage = 400–1000 V Time constant rise of anode supply voltage min. 2 ms	

GAS-FILLED TUBES - Ignitrons

Type	*Ignitor characteristics*		*Single phase A.C. control (2 tubes in inverse parallel connection)*					*Water flow*	*Max. dimensions*	
	$V_{ign.}$ (*V*)	$I_{ign.}$ (*A*)	V_{main} ($V_{a.c.}$)	T_{av} (*max.*) (*s*)	*P*(*max.*) (*kVA*)	I_{av} (*max.*) (*A*)	δ (%)	*q* (*l/min*)	*diam.*	*length*
PL5555 f=25–60 Hz	< 200	< 15	2400	1.66	2400	135		min. 9	146	570
ZX1051 f=25–60 Hz	150	6–8	250	18.0	600	30.2	2.8	min. 2	70	614
		< 12	380	11.8	600	30.2	4.2			
			600	7.5	600	30.2	6.7			
ZX1052 f=25–60 Hz	150	6–8	250	14.0	1200	75.6	3.5	min. 5	104	651
		< 12	380	9.4	1200	75.6	5.3			
			600	5.8	1200	75.6	8.4			
ZX1053 f=25–60 Hz	180 V	6–8	250	11.0	2400	192	4.4	min. 9	146	695
		< 12	380	7.3	2400	192	6.8			min.
			600	4.6	2400	192	10.6			
ZX1060 f=25–60 Hz	150	6–8	250	18.0	630	21	1.9	min. 3	70	196
		< 12	380	11.8	850	21	2.1			
			600	8.0	1200	21	2.3			
ZX1061 f=25–60 Hz	150	6–8	250	24.0	630	38	3.3	min. 3	70	634
		< 12	380	15.8	850	38	3.8			
			600	10.0	1200	38	4.2			

ZX1062	150	6–8	250	21.0	1250	110	4.9	min. 6	104	600
f=25–60 Hz		<12	380	13.8	1650	110	5.6			
			600	8.7	2300	110	6.4			
ZX1063	180	6–8	250	12.5	2500	210	4.7	min.10	146	695
f=25–60 Hz		<12	380	8.4	2750	210	6.5			(min.)
			600	5.3	3225	210	8.7			
ZX1081	150	6–8	250	18,0	600	30,2	2,8	min. 2	70	526
f=25–60 Hz		<12	380	11,8	600	30,2	4,2			
			600	7,5	600	30,2	6,7			
ZX1082	150	6–8	250	14,0	1200	75,6	3,5	min. 5	104	572
f=25–60 Hz		<12	380	9,4	1200	75,6	5,3			
			600	5,8	1200	75,6	8,4			

NUCLEAR DEVICES - Radiation counter tubes

Type	*Description*	*Radiation sensitivity*	*Wall thickness* (mg/cm^2)	*Anode resistor* ($M\Omega$)	*Plateau Operating voltage* (V)	*Max. plateau slope* ($\%/V$)	*Max. dead time* (μs)	*Max. backgr. (shielded)* (*counts/min.*)	*Eff. length Window diam.* (*mm*)	*Max. dimensions* *diam.* (*mm*)	*length* (*mm*)
ZP1080	Dip counter	β,γ	30	3.9	450–600	0.15	60	50	70	20	175
ZP1083	Dip counter								70	35	145
ZP1100	Cylinder counter with a filter	γ	80–100	2.2	500–650	0.15	15	2	16	10	37
18503	Cylinder counter	γ	250	10	400–600	0.04	90	10	40	17	55
18504	Mica window counters	β,γ	2.0–3.0 [1]	10	400–600	0.04	90	10	9∅	17	55
18505		α,β,γ	1.5–2.0 [1]	10	450–700	0.02	175	15	19.8∅	26	57
18506		β,γ	2.5–3.5 [1]	10	450–700	0.035	190	25	27.8∅	34	57
18507	End window counter	X-ray	2.5–3.5 [1]	4.7	1600–2000	0.04	110	25	107	26	127

18509	High flux counter	β,γ	80–100	2.2	500–650	0.15	15	2	16	6.2	37
18511	Side window counter	X-ray	2.0–2.5 [1])		1500–1850				67	27	128
18515	Low level mica	α,β	1.5–2.0 [1])	4.7	500–700	0.09	65	5	19.8Ø	26	30
18516	window counters	β	10 [1])	10	500–750	0.03	70	9	27.8Ø	34	34
18515/01	End window counter	α,β	1,5–2,0 [1])	4,7	500–750	0,09	65	8	19,8Ø	26	30
18518	Guard counter for 18515 or 18536		1 mm	10	800–1200	0.03	1000	70		80	90
18520	Cylinder	γ	0.7 mm	2.7	375–475	0.15	220	40	140	23.6	170
18522	counters		0.5 mm	10	600–1000	0.03	550	160	400	42	480
18526	End window counter	α,β,γ	1.5–2.0 [1])	10	450–700	0.035	190	25	27.8Ø	34	57
18527	End window counter	α,β,γ	1.5–2.0 [1])	10	450–700	0.035	190	25	37	35	86
18529	High flux counter	β,γ	80–100	2.2	500–600	0.3	11	1	8	6.2	25
18536	Low level mica window counters	α,β	1.5–2.0 [1])	10	500–750	0.07	60	9	27.8Ø	34	34
18536/01		α,β	1,5–2,0 [1])	10	500–750	0,07	60	12	27,8Ø	34	34
18545	Cylinder counter	γ	525	2.7	380–480	0.1	200	75	240	23.6	270

[1]) Window thickness.

NUCLEAR DEVICES - Radiation counter tubes

Type	*Description*	*Radiation sensitivity*	*Wall thickness* (mg/cm^2)	*Anode resistor* ($M\Omega$)	*Plateau Operating voltage* (V)	*Max. plateau slope* (%/V)	*Max. dead time* (μs)	*Max. backgr. (shielded)* (*counts/min*)	*Eff. length Window diam.* (*mm*)	*Max. dimensions* *diam.* (*mm*)	*length* (*mm*)
18546	End window counter	β	3.5–4.0 [1])	4.7	700–1100	0.04	45	30	51∅	58	45
18550			32–40	4.7	500–650	0.08	45	12	28	10	52
18552	Thin wall cylinder counters	β,γ	40–60	2.2	450–800	0.02	70	30	75	19	142
18553			40–60	2.2	450–800	0.02	100	60	185	19	290
18555			40–60	2.2	450–800	0.02	70	30	75	19	142

[1]) Window thickness.

Type	*Applications*	*Charactersitics*				
SAM series	Zn S-scintillator for α and $\alpha+\beta$ radiation detection	Time constant of fluorescence	0.1–1 μs			
		Wave length of a max. emission	450 nm			
		Max. amb. temperature	40°C			
		Detection efficiency min.	47.5%			
		av.	60%			
SIS series	NaI (TI) crystal scintillator for γ and X-rays detection and spectrometry	Time constant of fluorescence	$0.25 \cdot 10^{-6}$ s			
		Time constant of phosphorescence	$2.5 \cdot 10^{-3}$ s			
		Wavelength of max. emission	425 nm			
		Density	3.67			
		Refractive index	1.77			
		Max. temperature gradient	10°C min^{-1}			
			SPF	SPP	SPT	
SPF **SPP** **SPT**	Fluorescent plastic scintillator for α, β, γ, protrons, fast neutrons and cosmic rays detection	Decay constant with ^{60}Co source	3.6 ± 0.06	2.14 ± 0.06	2.10 ± 0.06	ns
		Relative light output (compared with SPF32/25 and a ^{239}Pu source)	1	1.30	1.22	
		Wavelength of maximum emission	440	425	425	nm
		Density	1.05	1.02	1.04	
		Refractive index	1.594	1.585	1.592	
		Ratio no. of H-atoms to no. of C-atoms	0.998	1.103	1.036	
		Softening point	85	75	80	°C
		Spectrum width at half max.	80	50	50	nm
SPH series	Plastic hornyak scintillator for fast neutrons measurement in nuclear reactors	Time constant of fluorescence	0.1–1 μs			
		Wavelength of max. emission	450 nm			
		Softening point	80–85°C			
		Response to fast neutrons	1.5%			
		Ratio no. of H-atoms to no. of C-taoms	≈ 1.0			

NUCLEAR DEVICES - Photoscintillators

Photoscintillators for X-ray spectrometry and medical applications

These types comprise a photomultiplier and a thin NaI (Tl) scintillator (with the exception of type PS 1014 SF) as well as a mu-metal screen.
The voltage divider is incorporated (with the exception of types PS1010 and PS5302)
The envelope of the photoscintillator is made of stainless steel.
The scintillators have a Be window or an Al window (thickness 0.2 mm).

Type	*Photomultiplier tube type:*	*Scintillator*	*Max. dimensions*	
			diam.	*overall length*
PS1010	XP1010	SIS 32 × 2	48	131
PS1011	XP1010	SIS 32 × 2	46	181
PS1012	XP1010	SIS 32 × 2	46	192
PS1013	XP1010	SIS 32 × 6	48	167
PS1014	As type PS1013 but with a construction, which makes it possible to mount a collimator.			
PS1014SF	As type PS1013 but with accommodation for an interchangeable NaI (Tl) scintillator. These scintillators (to be ordered separately) are delivered in an adapted mount, which can be screwed into the probe. The max. diameter of the scintillator is 25 mm, the thickness depends on the application.			
PS5302	53AVP/02	SIS 44 × 2	63.2	157

Basic miniature probes for nuclear and photometric applications

These types comprise a photomultiplier, a voltage divider and a mu-metal screen.
They have accommodation to mount easily an alpha-, beta-, gamma- or fast neutron scintillator (to be ordered separately).
The envelope of the probe is made of stainless steel.

Type	*Photomultiplier Type:*	*Max. dimensions*	
		diam.	*overal length*
PS1520	XP1110/01	24.3	165
PS1521	XP1110	24.3	165

Photoscintillator for gamma-ray detection and -counting in liquids

This watertight type comprises a photomultiplier, a NaI (Tl) scintillator and a pre-amplifier as well as a mu-metal screen.
The voltage divider is incorporated.
The envelope of the photoscintillator is made of stainless steel and provided with a flange for easy mounting.
The stainless steel window of the scintillator has a thickness of 0.5 mm.

Type	*Photomultiplier tube Type:*	*Scintillator*	*Max. dimensions diam.*	*overall length*
PS1531	53AVP	SIS 44 × 50	130	303

Basic miniature probes for nuclear applications

These types comprise a photomultiplier, a voltage divider and a mu-metal screen.
They have accommodation to mount easily a plastic scintillator coupled with a light guide (both to be ordered separately).
The envelope of the probe is made of soft iron and aluminium.

Type	*Photomultiplier tube Type:*	*dimensions diam.*	*overall length*
PS2010/50	12 stage version of type XP1115	36	230
PS2010/100	As type P2010/50 but with a 100 Ω output connection instead of 50 Ω	36	230

NUCLEAR DEVICES - Photoscintillators

Rectangular photoscintillators for nuclear applications

These types comprise a photomultiplier and a SPABM or SPF scintillator as well as a mu-metal screen.
The voltage divider is incorporated.
The envelope of the photoscintillator is made of aluminium.
These types are insensitive to light.

Type	*Photomultiplier tube Type:*	*Scintillator*	*Max. dimensions height*	*width*	*overall length*
PS5400	54AVP	SPABM 139 × 209	237.2	165.5	382
PS5410	54AVP	SPF 139 × 209	237.2	165.5	382

Photoscintillators for gamma-ray spectrometry

These types comprise a photomultiplier and a NaI (Tl) scintillator (with or without well) as well as a mu-metal screen.
The voltage divider is not incorporated.
The envelope of the photoscintillator is made of aluminium.
The aluminium window of the scintillator has a thickness of 0.5 mm.

Type	*Photomultiplier tube type:*	*Scintillator*	*Resolution for* 137_{Cs}; 661 *keV*	*Max. dimensions diam.*	*overal length*
XP1050	153AVP	SIS 44 × 50	⩽9%	63	207
XP1051	153AVP	SIS 44 × 50	⩽10%	63	207
XP1052	XP1001	SIS 44 × 50	⩽8%	63	205
XP1053	XP1001	SIS 44 × 50	⩽10%	63	205
XP1190	XP1031	SIS 75 × 63	⩽9%	82.5	230
XP1191	XP1031	SIS 75 × 75	⩽8.5%	82.5	242
XP1192	XP1031	SIS 75 × 75	⩽11%	82.5	242
XP1193	XP1031	SIS 75 × 50	⩽9.5%	82.5	216
XP1200	150AVP (selected)	SIS 38 × 25	⩽9%	46.2	156

Universal photoscintillator base assembly

This type is essentially a probe-like mechanical system with provisions for mounting a photomultiplier tube, a voltage divider, a limiter and a scintillator or lightguide.
The necessary wiring is already present as well as printed wiring boards carrying the limiter and voltage divider.
The photomultiplier, scintillator lightguide or fastening clip must be ordered separately.

S5600:	HT supply of the photomultiplier	max. 2500 V
	HT supply current	max. 1.20 mA/kV
	Limiter supply voltage	24 V
	Limiter supply current	35 mA

The following versions are available:

S5600/01: Complete assembly with:
- mu-metal and soft-iron shields
- fastening rings for lightguide or scintillator
- socket for the photomultiplier
- decoupling capacitors for the photomultiplier
- 2 printed circuit boards carrying the voltage divider
- 1 printed circuit board carrying the limiter.

This assembly is intended for use with a photomultiplier type 56 AVP, 56 DVP, 56 DUVP, 56 TVP, 56 TUVP or 56 UVP.

S5600/02: As type S5600/01 but for use with a photomultiplier type 56 CVP.

S5600/03: As type S5600/01 but for use with a photomultiplier type 58 AVP, 58 DVP, 58 UVP, XP1040 or XP1041.

Pulsed-light source

Intended for use in applications where a very short light pulse is needed e.g., time response measurements of photoelectric devices. It comprises a pulsed-light unit with monitor diode, and a power and pulse supply unit.

SL109:	Light pulse rise time	max. 0.5 ns
	Light pulse width at half height	max. 0.9 ns
	Pulse repetition frequency	0–150 p.p.s.
	Coaxial outlets, synchronization and monitor signals	50 Ω

NUCLEAR DEVICES - Neutron generator tubes

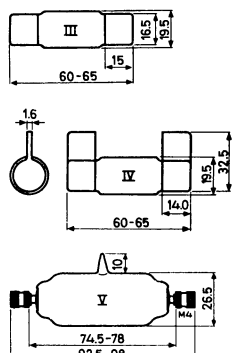
Type	*Typical operating*				*Max. dimensions*	
					diam.	*length*
18600R	Neutron output Accelerating voltage	min. 10^8 n/s 125 $kV_{d.c.}$	Target current Ambient temperature	100 $\mu A_{d.c.}$ 25°C	70	726
		continuous	*pulsed*		70	762
18601	Neutron output Pulse duration Accelerating voltage Target current Ambient temperature	$2 \cdot 10^8$ – 125 100 25	$2 \cdot 10^{11}$ n/s 5 to 1000 μs 125 kV mean 100 μA 25°C			
18602	Neutron output Accelerating voltage	$3 \cdot 10^{10}$ n/s 150 kV	Target current Ambient temperature	1.5 mA 25°C	150	680
		continuous	*pulsed*		70	726
18603	Neutron output Pulse duration Accelerating voltage Target current Ambient temperature	$2 \cdot 10^8$ – 125 100 25	$2 \cdot 10^8$ n/s 5 to 1000 μs 125 kV mean 100 μA 25°C			

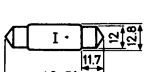
Lithium drifted germanium detectors		
Coaxial	Ture coaxial (double open-ended)	APY21 to APY27
	Coaxial, closed ended	APY41 to APY49
	Well type	APY56 to APY59
Planar	Standard	APY16 to APY19
	Thin window	APY30, APY31
		APY36 to APY38
Lithium drifted silicon detectors		BPX10 to BPX14
		BPX56, BPX57
Silicon surface barrier detectors		
Partially depleted	Circular	BPY51 to BPY57
	Annular	BPY58, BPY59
Totally depleted	Circular	BPY81 to BPY87
	Annular	BPY88, BPY89
Chequer-board		BPY75–300
	Diffused silicon detectors	BPY20 to BPY24
	Pre-amplifiers	56050–01/56054–01 to 56057–01/56059
Cryostats		CRY201 to CRY204

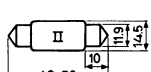
For full information on semiconductor radiation detectors and accessories please ask for "Product Survey Semiconductor Radiation Detectors"

MISCELLANEOUS - Rare gas cartridges

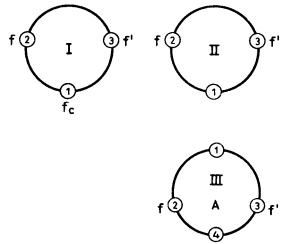
Type	*Starting voltage (V)*	*Min. extinguishing voltage (V)*	*Max. surge current (A) during (sec)*		*Max. fuse in series (A)*	*Capacitive discharge (Ws)*	*Max. line voltage* ($V_{=}$)	($V_{\sim}$)	*Dimensions see fig.:*
4349	130–180	110	5	3	6	10	70	75	I
4369	150–200	110	10	3	10	10	70	75	IV
4370	80–120	60	10	3	10	10	36	50	IV
4371	150–250	110	5	3	6	10	70	75	II
4372	280–350	250	2.5	1	6	10	200	180	IV
4378	80–120	60	10	3	10	10	36	50	III
4379	280–350	130	10	3	10	10	50	180	IV
4383	280–350	130	5	3	6	10	50	180	II
4390	700–910	200	25	3	25	500	175	300	V
4397	400–500	200	5	1	6	10	150	230	IV



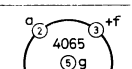
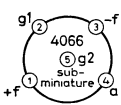
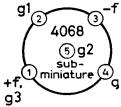
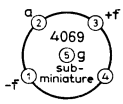




Type	*V* (*V*)	$I_{tot.}$ (*A*)	*at V* (*V*)	*Max. dimensions* *diam.*	*length*	*Base*	*Base connections*
329	10–30	1.08–1.22	20	34	119	I	
340	3–10	5.5–6.3	7	53	156	Edison	
1904	30–80	0.096–0.104	60	39	110	II	
1905	2–6	0.96–1.04	4	35	100	Edison	
1908	5–15	0.76–0.86	7	35	107	II	
1909	5–45	0.60–0.67	30	56	123	II	
1910	5–15	1.35–1.50	8.5	35	110	II	
1927	40–120	0.172–0.188	80	40.5	138	III	
1928	80–240	0.172–0.188	160	40.5	147	III	
1941A	80–200	0.29–0.31	140	53	162	Edison + III	

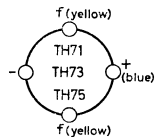


MISCELLANEOUS - Electrometer tubes

Type and application	V_f (V) I_f (mA)	*Characteristics data (Typical)*			*Limiting values*	*Base connections*
4065 Triode	1.25 13	V_a = 9 V V_g = −2.5 V	I_a = 100 μA S = 80 μA/V	μ = 2 $-I_g$ = 8.5 × 10⁻¹⁴ A [1])	V_a = 25 V I_a = 250 μA V_f = < 1.5 V > 1.1 V	
4066 Tetrode	1.25 13	V_a = 4.5 V V_{g2} = −3.2 V V_{g1} = 3 V	I_a = 20 μA $-I_{g2}$ = 2.5 × 10⁻¹⁵ A	S_{ag2} = 17 μA/V I_{g1} = 250 μA [1])	V_a = 10 V I_k = 300 μA V_f = < 1.5 V > 1.1 V	
4068 Pentode	1.25 8.2	V_a = 10 V V_{g2} = 6.5 V V_{g1} = −2.5 V	I_a = 5 μA I_{g2} = 2.2 μA I_{g1} = 3 × 10⁻¹⁵ A [1])	S = 10.5 μA/V R_1 = 10.5 MΩ μ_{a-g1} = 110	V_a = 45 V V_{g2} = 45 V I_k = 180 μA V_f = < 1.5 V > 1.1 V	
4069 Triode	1.25 14	V_a = 9 V V_g = −2.7 V	I_a = 100 μA S = 80 μA/V	$-I_g$ = 1.6 × 10⁻¹³ A [1]) μ = 2	V_a = 25 V I_a = 250 μA V_f = < 1.5 V > 1.1 V	

[1]) Valid only in darkness

MISCELLANEOUS - Thermocouples

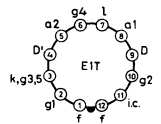
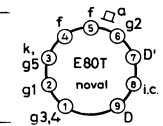
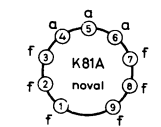
Type	*Characteristics and limiting values*								*Base connections*
	I_f (*mA*)	I_f [1] (*mA*)	I_f ($E=12$ *mV*) (*mA*)	*Max.* I_f (*mA*) *t max. 1 min.*	R_f (Ω)	R_{th} (Ω)	*Max. dimensions* *diam.*	*length*	
TH71	0–15	0–5	10	20	68	6.0			
TH73	0–75	0–20	40	100	7.0	3.5	7.9	25	
TH75	0–300	0–100	200	350	1.2	3.5			

MISCELLANEOUS - Dry reed switches

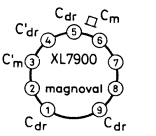
		$P_{max.}$	$V_{max.}$	$I_{max.}$	*Max. dimensions* *diam.*	*length (except leads)*
RI-12	Single-pole, single-throw, normally open	5 W	65 V	100 mA	3.97	28.3
RI-20	Single-pole, single-throw, normally open	10 W	100 V	500 mA	2.8	15

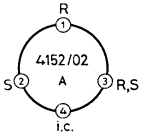
[1]) In this range V_o is proportional to the square of I_f

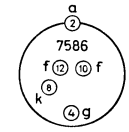
MISCELLANEOUS

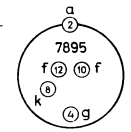
Type	V_f (V) I_f (A)	*Characteristics data*			*Limiting values*	*Base connections*
		Operating				
E1T Decade- counter tube	6.3 0.3	V_b = 300 V V_{bg1} = 11.9 V V_{bg2} = 300 V V_D = 156 V	V_l = 300 V I_k = 0.95 mA I_{g2} = 0.1 mA R_k = 15 kΩ	R_{g4} = 47 kΩ R_{a1} = 39 kΩ R_{a2} = 1 MΩ	V_b = 400 V	
		Typical				
E80T Beam- deflection tube	6.3 0.15	V_a = 100 V V_{g3+4} = 250 V V_{g2} = 70 V	V_{g1} = 0 V V_D = 120 V V_D = 120 V	I_a = 1.35 mA I_k = 2.0 mA	V_a = 330 V I_k = 55 mA V_{kf} = 50 V	
		Typical				
K81A Noise diode	1.85 2.5	V_a = 100 V	I_a = 15 mA	F = 13 dB	V_f = 2.0 V V_a = 150 V I_a = 20 mA W_a = 3 W	

XL7900 Vibrating capacitor		Contact potential over $C_m - 50$ to $+50$ mV Short term drift of contact potentional $< 100\ \mu V$	Insulation $> 10^{15}\ \Omega$ Temp. dependence 20 $\mu V/°C$		$V_{Cm} = 25$ V	
4152/02 Bimetal relay	I_r 85–115 mA $R = 370\ \Omega$	$V_m = 220\ V_{d.c.}$ $V_m = 220\ V_{a.c.}$ $V_m = 380\ V_{a.c.}$	$I_{max.} = 1.5$ A $I_{max.} = 1.5$ A $I_{max.} = 0.7$ A When switching on	$I_{max.} = 250$ mA $I_{max.} = 250$ mA $I_{max.} = 75$ mA When switching off	$I_r = 125$ mA $t_{amb} = -10°C$ $+60°C$	
		Typical				
7586 Nuvistor triode	6.3 0.135	$V_{ba} = 75$ V $V_{bg} = 0$ V $R_k = 100\ \Omega$	$C_k = 1300\ \mu F$ $I_a = 10.5$ mA $S = 11.5$ mA/V	$R_i = 3\ k\Omega$ $\mu = 35$	$V_a = 110$ V $I_k = 15$ mA $W_a = 1$ W	
		Typical				
7895 Nuvistor triode	6.3 0.135	$V_{ba} = 110$ V $V_{bg} = 0$ V $R_k = 150\ \Omega$	$C_k = 1000\ \mu F$ $I_a = 7$ mA $S = 9.4$ mA/V	$R_i = 6.8\ k\Omega$ $\mu = 64$	$V_a = 110$ V $I_k = 15$ mA $W_a = 1$ W	

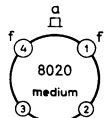
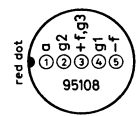








MISCELLANEOUS

Type	V_f (V) I_f (A)	*Characteristics data*			*Limiting values*	*Base connections*
		Typical	*Surge limiter*	*Rectifier*	*Surge limiter*	
8020 High-vacuum high-voltage diode	5.0 6.0	$V_a = 200$ V $I_a = 100$ mA	$V_f = 5.5$ V $V_{ap} = 10$ kV $I_{ap} = > 2$ A	$V_{ainvp} = < 40$ kV $I_a = < 100$ mA $I_{ap} = < 750$ mA	$V_f = 5.8$ V $V_{ap} = 12.5$ kV $W_a = 75$ W $V_{ainvp} = 40$ kV	
		Typical				
95108 Transmitting pentode for use in radio sondes	1.25 0.045	$V_a = 45$ V $V_{g2} = 45$ V $V_{g1} = -2.75$ V	$I_a = 875\ \mu$A $I_{g2} = 200\ \mu$A $S = 650\ \mu$A/V	$R_i = 0.75$ MΩ $\mu_{g2g1} = 9.3$	$V_a = 120$ V $I_k = 16$ mA $W_a = 1.0$ W $W_{g2} = 0.2$ W	

REPLACEMENT GUIDE
ELECTRON TUBES

Type to be replaced	CV number	Replacement type
0.1NE3/1		(ZP1010)
1A3	753	1A3;DA90
1BG2		1BG2;DY51
1BQ2		1BQ2;DY802
1CP31	2302	1CP31;DH3-91
1G35P		4C35A;6268
1G45P		3C45
1H2		1BQ2;DY802
1M3	2980	1M3;DM70
1N3		1N3;DM71
1N16		(RG1-240A)
1P23		(3554)
1P32		(3546PW)
1P37		(90AG)
1P41		(53CG)
1S2		1BQ2;DY802
1S2A		1BQ2;DY802
1.5NG12		(ZP1010)
2B29		(5894);(QQE06/40)
2B32		832A;QQE04/20
2B46		6146;QE05/40
2B52		6252;QQE03/20
2B94		5894;QQE06/40
2C39A	2516	2C39A
2C39BA		2C39BA;7289
2D21	797	PL2D21;EN91; PL5727;M8204
2D21W	2876	PL5727;M8204
2D21WA	4018	PL5727;M8204
2E24		(2E26);(QV05-10)
2E26	3990	2E26;QV05-10
2G57		PL5557
2G402A		DCX4/1000;3B28
2G/472B		DCX4/5000;4B32
2H28		3B28;DCX4/1000
2H66		866A;DCG4/1000G
2HA5		2HA5;XC900
2HR8		2HR8;XF86
2J42	3676	2J42
2J51	3560	2J51
2J51A	5134	2J51A
2J55		2J55
2K25	2792	2K25
2M88		YJ1420
2V/400A	32	DCG4/1000G;866A
2V/400B		(DCG4/1000G);(866A)
2V/470C		(DCG4/5000)
2V/471A		(DCG4/5000)
2V/490C		(DCG4/5000)
2V/500C		(DCG4/5000)
2V/530A		(DCG9/20);(6508)
2V/530E		(DCG9/20);(6508)
2V/531E		(DCG9/20);(6508)
3AJ8		3AJ8;XCH81
3AL5		3AL5;XAA91
3ALP1	2175	3ALP1;DG7-5
3ALP7	5171	3ALP7;DP7-5
3ALP11		3ALP11;DB7-5

Type to be replaced	CV number	Replacement type
3AMP1	2431	3AMP1
3AMP1A		3AMP1A;DG7-32
3B28	1835	3B28;DCX4/1000
3BH2		3BH2;GY501
3BKP2		3BKP2;DN7-78
3BKP7		3BKP7;DP7-78
3BKP11		3BKP11;DB7-78
3BKP31		3BKP31;DH7-78
3BYP2		3BYP2;DN7-11
3BYP7		3BYP7;DP7-11
3BYP11		3BYP11;DB7-11
3BYP31		3BYP31;DH7-11
3C4		3C4;DL96
3C23A		PL3C23A
3C45	6007	3C45;PL345
3C800E		TB5/2500
3CJA		3CJA/5684
3CX100A5		7289
3E29	2295;3599	3E29;QQV5-P10
3EH7		3EH7;XF183
3EJ7		3EJ7;XF184
3F65		QB3/200
3G49P		5949
3G/501A		PL5545A
3G/502A		PL6807
3GK5		3GK5
3HA5		3HA5;LC900
3V/340B		(PL5557)
3V/390A	5027	PL5559
3V490A		(PL105)
3V/531E		(DCG12/30;(5870)
3WP1	3946	3WP1;DG7-36
3WP2		3WP2;DN7-36
3WP7		3WP7;DP7-36
3WP11		3WP11;DB7-36
4-65A	1905	4-65A;QB3/200
4-125A	2963	4-125A;QB3/300GA
4-250A	2964	4-250A;QB3.5/750GA
4-400A	3879	4-400A;QB4/1100GA; YL1461
4B13		QB2/250
4B26	1836	1163
4B32	2518	4B32;DCX4/5000
4BL8		4BL8;XCF80
4C35	1787	4C35A;6268
4C35A	5247	4C35A;6268
4CM4		4CM4;PC86
4CX250B		4CX250B;QEL2/275
4CX250F		4CX250F;QEL2/275H
4CX250FG		4CX250FG;8621
4CX250R		4CX250R;7580W
4CX350A		8321;YL1340
4CX350F		8322;YL1341
4D21	2963	4-125A;QB3/300GA
4DL4		4DL4;PC88
4EH7		4EH7;LF183
4EJ7		4EJ7;LF184
4ER5		4ER5;PC95
4ES8		4ES8;XCC189
4F15R		4X150A;QEL1/150
4F20R		4X150D
4F21		QB3/300;6155
4FY5		4FY5;PC97
4G/280K		PL2D21;EN91; PL5727;M8204

Type to be replaced	CV number	Replacement type
4GJ7		4GJ7;XCF801
4GTP		(3546PW)
4H/135M		QEL1/50;4X150A
4H/136M		QEL1/150H;4X150D
4H/160M		QEL2/250;4X250B
4HA5		4HA5;PC900
4J	2797	QQE06/40;5894
4J50		4J50
4J50A		4J50A
4J52A	5018	4J52A
4JW8		4JW8;XCF802
4KM50000LA		(YK1000)
4KM50000LA3		(YK1000)
4KM50000LF		(YK1004)
4Q025		RG3-250
4X150A	2519	4X150A;QEL1/150
4X150D	3991	4X150D;QEL1/150H
4X150B	2487	4X250B;QEL2/250
4X500A		4X500A;QBL4/800

Type to be replaced	CV number	Replacement type
5BHP31	5168	5BHP31;DH13-78
5C21		PL5545A
5C22	2520	5C22;6279
5C/100A		QB2/250;813
5CBP2		5CBP2;(D13-15GP)
5CBP11		5CBP11;(D13-15BE)
5CBP31		5CBP31;(D13-15GH)
5CLP2		5CLP2;DN13-10
5CP1A		(DG13-2)
5CP7A	3954	(DP13-2)
5CP11A		(DB13-2)
5D22	2964	4-250A;QB3.5/750GA
5F20RA		QEL2/275
5F22		QB3.5/750GA
5F23		QB4/1100GA
5GJ7		5GJ7;LCF801
5HG8		5HG8;LCF86
5J		(2 × YL1230)
5J26	3602	5J26
5T33		(TB4/1250);(5868)
5U9		5U9;LCF201
5UP1		DG13-32

5/62CM		DH13-78;5BHP31
5A/160H		EF91;6AM6
5A/170K		E180F;6688
5ADP1	5035	5ADP1;DG13-34
5ADP2		5ADP2;DN13-34
5ADP7	5125	5ADP7;DP13-34
5ADP11		5ADP11;DB13-34
5AR4	1377	5AR4;GZ34
5B21		1164
5B/250A	124	QE06/50;807

6AB8		6AB8;ECL80
6AF9		6AF9
6AJ8	2128	6AJ8;ECH81
6AJ9		6AJ9;ECF202
6AK5	850	6AK5;EF95
6AK5W	4010;5216	6AK5W;E95F
		5654;M8100
6AK8		6AK8;EABC80
6AL3		6AL3;EY88
6AL5	283	6AL5;EAA91

Type to be replaced	CV number	Replacement type
6AL5W	4007;5189	6AL5W;5726; E91AA;M8212
6AM5	136	6AM5;EL91
6AM6	138	6AM6;EF91
6AM6S		6AM6S;M8083
6AQ4	417	6AQ4;EC91
6AQ5	1862	6AQ5;EL90
6AQ8		6AQ8;ECC85
6AS6W	4011	6AS6W;5725
6AT6	452	6AT6;EBC90
6AU6	2524	6AU6;EF94
6AU8		(6BL8);(ECF80)
6AU8A		(6BL8);(ECF80)
6AV6	2526	6AV6;EBC91
6BA6	454	6BA6;EF93
6BA6W	5037;4009	6BA6W;5749
6BD7		6BD7;EBC80
6BD7A		6BD7A;EBC81
6BE6	453	6BE6;EK90
6BK6		6AV6;EBC91
6BL8	5215	6BL8;ECF80
6BH6		(7693);(E90F)
6BM8		6BM8;ECL82
6BN5	3526	6BN5;EL85
6BQ5	2975	6BQ5;EL84
6BR5	1352	6BR5;EM80
6BT4	3891	6BT4;EZ40
6BX6	1376	6BX6;EF80
6BY7	1375	6BY7;EF85
6C4	133	6C4;EC90
6C10		6CU7;ECH42
6C12		6AJ8;ECH81
6C16		6BL8;ECF80
6CA4	5072	6CA4;EZ81
6CA7	1741	6CA7;EL34

Type to be replaced	CV number	Replacement type
6CH6	2127	6CH6;EL821
6CJ3		(6EC4A);(EY500A)
6CJ5	3886	6CJ5;EF41
6CJ5	2721	6CJ6;EL81
6CK5	3889	6CK5;EL41
6CK6	2726	6CK6;EL83
6CM4		6CM4;EC86
6CM5	2940	6CM5;EL36
6CQ6	131	6CQ6;EF92
6CS6		6CS6;EH90
6CT7	3883	6CT7;EAF42
6CU7	3888	6CU7;ECH42
6CV7	3882	6CV7;EBC41
6CW5	5094	6CW5;EL86
6CW7	5281	6CW7;ECC84
6D2		EB91
6D4		6D4;EN93
6D5	1949	6D4;EN93
6DA5	5055	6DA5;EM81
6DA6	5156	6DA6;EF89
6DC8		6DC8;EBF89
6DJ8	5358	6DJ8;ECC88
6DL4		6DL4;EC88
6DL5		6DL5;EY500A
6DR8		6DR8;EBF83
6DS8		6DS8;ECH83
6DX8		6DX8;ECL84
6DY5		6DY5;EL82
6EC4, 6EC4A		6EC4A;EY500A
6ED4		6ED4;ED500
6EH7		6EH7;EF183
6EJ7		6EJ7;EF184
6EL7		6BX6;EF80
6ES6		6ES6;EF97

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Type to be replaced	CV number	Replacement type
6ES8		6ES8;ECC189
6ET6		6ET6;EF98
6F12		6AM6;EF91
6F16		6CJ5;EF41
6F19		6BY7;EF85
6F21		6CQ6;EF92
6F23		6BX6;EF80
6F26		6F26;EF85
6F29		EF183;6EH7
6F30		EF184;6EJ7
6F50R		QBL4/800;4X500A
6FC7		6FC7;ECC89
6FD12		6DC8;EBF89
6FG6		6FG6;EM84
6FW8		(6ES8);(ECC189)
6FY5		6FY5;EC97
6G45		PL5545A
6GB5		6GB5;EL500
6GB5A		6GB5A;EL504
6GH8A		6GH8A
6GJ7		6GJ7;ECF801
6GM8		6HM8;ECC86
6GV8		6GV8;ECL85
6GW8		6GW8;ECL86
6H51		(DCG6/18);(6693)
6HA5		6HA5;EC900
6HG8		6HG8;ECF86
6HU6		6HU6;EM87
6J4WA	5311	(M8248)
6J6	858	6J6;ECC91
6JE6		(6KG6A);(EL509)
6JS6		(6LF6)
6JW8		6JW8;ECF802
6JX8		6JX8;ECH84

Type to be replaced	CV number	Replacement type
6K4	468	EC70;6778
6KD6		(6LF6)
6KG6, 6KG6A		6KG6A;EL509
6KM6		(6KG6A/EL509)
6KN6		(6LF6)
6KW6		6KW6;EL508
6L12		6AQ8;ECC85
6L13		12AX7;ECC83
6L16		6CW7;ECC84
6LB6		(6LF6)
6LD3		6CV7;EBC41
6LD6		6LD6;EL802
6LD12		6AK8;EABC80
6LF6		6LF6
6LV6		6LV6;(6LF6)
6LX8		6LX8;LCF802
6M5		6M5;EL80
6N3		6N3;EY82
6N8		6N8;EBF80
6P15		6BQ5;EL84
6Q4	1886	6Q4:EC80
6R3		6R3;EY81
6R4	1865;1888	6R4;EC81
6S2, 6S2A	2666	6S2A;EY87
6SN7GT		6SN7GTB
6SN7GTB		6SN7GTB
6T40		TB4/1500
6T50		TB5/2500
6T51		(TB5/2500)
6T61R		(TB4/1250)
6T66R		(TB4/1500)
6U3		6U3;EY80

Type to be replaced	CV number	Replacement type
6U9		6U9;ECF201
6V4	1535	6V4;EZ80
6V9		6V9;ECH200
6X2	426	6X2;EY51
6X4	493	6X4;EZ90
6X9		6X9;ECF200
6Y9		6Y9;EFL200
7C24		(YD1120)
7D9		6AM5;EL91;M8082
7D10		EL821;6CH6
7DJ8		7DJ8;PCC88
7EF7		7EF7;PCC89
7ES8		7ES8;PCC189
7F16		6CJ5;EF41
7HG8		8HG8;PCF86
7T54RA		(TBL6/14)
7T62R		(TB5/2500)
8A1	1282	DG7-36;3WP1
8A8		9A8;PCF80
8B8		8B8;XCL82
8D3		6AM6;EF91; 6AM6S;M8083
8GJ7		8GJ7;PCF801
8HG8		8HG8;PCF86
8NE31		(ZP1000)
8U9		8U9;PCF201
8X9		8X9;PCF200

Type to be replaced	CV number	Replacement type
9A8		9A8;PCF80
9AK8		9AK8;PABC80
9AQ8		9AQ8;PCC85
9ED4		9ED4;PD500
9GV8		9GV8;XCL85
9JW8		9JW8;PCF802
9Q205		(DCG6/18);6693)
9U8		9U8;PCF82
9V9		9V9;PCH200
10C14		19D8;UCH81
10CW5		10CW5;LL86
10DX8		10DX8;LCL84
10FC12		19FL8;UBF89
10L14		UCC85
10LD3		14L7;UBC41
10LD12		UABC80
10LD13		UBC81
10NE40		(ZP1000)
10P18		45B5;UL84
11E13		QQE03/12;6360
11Y9		11Y9;LFL200
12AC5		12AC5;UF41
12AT7	455	12AT7;ECC81
12AT7WA	4024;5212	12AT7WA;E81CC; 6201;M8162
12AU7	491	12AU7;ECC82

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Type to be replaced	CV number	Replacement type
12AU7WA	4003	12AU7WA;(M8136)
12AX7	492	12AX7;ECC83
12AX7S		12AX7S;(M8137)
12AX7WA	4004	(M8137)
12EB20		(ZP1010)
12S7		12S7;UAF42
13CM5		13CM5;XL36
14ABP4		14ABP4;AW36-21
14ABP4A		14ABP4A;AW36-20
14AHP4		14AHP4;AW36-81
14GW8		14GW8;PCL86
14K7		14K7;UCH42
14L7		14L7;UBC41
14Y7		14Y7;UCH80
15A6		15A6;PL83
15CW5		15CW5;PL84
15DQ8		15DQ8;PCL84
16A5		16A5;PL82
16A8		16A8;PCL82
16AQ3		16AQ3;XY88
16LD6		16LD6;PL802
16Y9		17Y9;PFL200
17		PL5557
17C8		17C8;UBF80
17DCP4		(AW43-88)
17DYP4		(AW43-89)
17KW6		17KW6;PL508
17Y9		17Y9;PFL200
17Z3		17Z3;PY81
18GB5		18GB5;LL500
18GB5A		18GB5A;LL504
18GV8		18GV8;PCL85
19ALP4		(AW47-91)
19AMP4		(19CWP4)
19AQP4		(AW47-91)
19ASP4		(19CWP4)
19BAP4		(19CWP4)
19BCP4		(19CWP4)
19BEP4		AW47-91
19CEP4		(19CWP4)
19CTP4		AW47-91
19CWP4		19CWP4
19CXP4		(AW47-91)
19D8		19D8;UCH81
19DJP4		AW47-91
19FL8		19FL8;UBF89
19SU		19Y3;PY82

Type to be replaced	CV number	Replacement type
19X3		19X3;PY80
19Y3		19Y3;PY82
20A2		PL6574
20A3	797	PL2D21;PL5727; M8204
20AQ3		20AQ3;LY88
20CG		20CG
20CV	5120	20CV
20LF6		20LF6
21A1		PL6574
21A6	5077	21A6;PL81
21B12A		PL5684
21DKP4		AW53-88
21DWP4		(AW53-88)
21ELP4		21CLP4
21ENP4		21CLP4
21EP4		(AW53-20)
21EXP4		(AW53-89)
21EZP4		(AW53-89)
21FCP4		(AW53-88)
22AL3		20AQ3;LY88
23ABP4		(AW59-90)
23ADP4		A59-16W
23AMP4		(AW59-90)
23AQP4		AW59-90
23AXP4		AW59-91
23AYP4		A59-16W
23BCP4		AW59-90
23BEP4		A59-16W
23BNP4		A59-16W
23BRP4		(A59-16W)
23BSP4		A59-16W
23BYP4		(A59-16W)
23CJP4		A59-16W
23CKP4		A59-16W
23CLP4		A59-16W
23CMP4		AW59-90;23CMP4
23CNP4		A59-16W
23CRP4		A59-16W
23CSP4		(A59-16W)
23CVP4		(A59-91)
23CPX4		(AW59-91)
23DEP4		A59-11W
23DFP4		AW59-91
23DGP4		A59-16W
23DHP4		A59-16W
23DJP4		(A59-16W)
23DRP4		(A59-11W)
23EBP4		AW59-90
23EJP4		AW59-91
23FGP4		A59-11W
23KP4/03		AW59-90
23RP4		(A59-16W)
23SP4		A59-16W
23VP4		(AW59-91)

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Type to be replaced	CV number	Replacement type
24AXP4		AW61-88
25E5		25E5;PL36
25LX6		(20LF6)
25MP4		A65-11W
27GB5		27GB5;PL500
27GB5A		27GB5A;PL504
27KG6		27KG6A;LL509
27KG6A		
27LF6		27LF6
27RP4		27RP4
28EB40/1B		(ZP1010)
28EC4		28EC4A;LY500A
28EC4A		
30AE3		30AE3;PY88
30C1		9A8;PCF80
30L1		7AN7;PCC84
30P16		16A5;PL82
30P18		15CW5;PL84
31A3		31A3;UY41
31AV3		31AV3;UY89
31EB40		(ZP1000)
31EB70G		(ZP1000)
38A3		38A3;UY85
40KG6		40KG6A;PL509
40KG6A		
42EC4		42EC4A;PY500A
42EC4A		
45A5	1977	45A5;UL41
45B5		45B5;UL84
45BA6		367
*50AVP		150AVP
*50AVP/02		XP1010
50B5		50B5
50MB8		50BM8;UCL82
*51AVP		150AVP
*51UVP		150UVP
52AVP		52AVP;(XP1180)
52CG	2896	52CG
53AVP		53AVP;(XP1000)
53CG		53CG
53DVP		53DVP
53UVP		53UVP;(XP1004)
54AVP		54AVP
54DVP		54DVP
54UVP		54UVP
*55AVP		56AVP
55N3		55N3;UY82
56AVP		56AVP
56AVP/05		56AVP/05
56CVP		56CVP
56DUVP		56DUVP
56DUVP/03		56DUVP/ 3
56DVP		56DVP
56DVP/03		56DVP/03
56SBUVP		56SBUVP
56TUVP		56TUVP
56TVP		56TVP
56UVP		56UVP
57		PL5559
57AVP		57AVP
58AVP		58AVP
58DVP		58DVP
58UVP		58UVP
60AVP		60AVP
60DVP		60DVP
60DVP/H		60DVP/H

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
61SV		61SV;7634
62DDT		6CV7;EBC41
62TH		6CU7;ECH42
62VP		6CJ5;EF41
63TP		6AB8;ECL80
64SPT		6BX6;EF80
65ME		6BR5;EM80
66KU		6BT4;EZ40
67BT		6CK5;EL41
75B1	284	75B1
75C1	2454	75Cl;M8225
76NB3		76NB3
83A1		83A1;7980
85A1	431	85A1;OE3
85A2	449	85A2;OG3; M8098
90AV	2132	90AV
90C1	5173	90C1;M8206
90CG		90CG
90CV		90CV
90NB3		90NB3
90NS		90NS
92AG		92AG
92AV		92AV
95A1	286	95A1
100C		100C
100CB		100CB
100E1		100E1
100NB		100NB
100R		8020
105A		PL105
108Cl	1833	OB2;OB2;OB2WA; M8224
120C		120C
120NB		120NB
121VP		UF41;12AC5
141DDT		UBC41;14L7
141TH		UCH42;14K7
150A1		150A1
150AV		150AV
150AVP		150AVP
*150AVP/02		XP1010
150B2	2225	150B2;6354;M8163
150C1		150C1
150C2	1832	OA2; OA2WA;M8223
150C3		150C3;OD3
150C4	1832	M8223
150CV		150CV
150CVP		150CVP
150TV		150TV
150UV		150UV
150UVP		150UVP
*152AVP		XP1110;(XP1115)
*152UVP		XP1118
153AVP		153AVP;(XP1001)
153C		153C
155N		155N
155UG		155UG
163Pen		PL82;16A5
171DDP		UBF80;17C8
172		(PL105)
172K		(MW43-69);(17BQP4)
173K		(MW43-69);(17BQP4)
200CB		200CB
200HB		200HB
200LB		200LB
200NB		200NB
210-0159		ZX1061

* Obsolete type with replacement type

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Type to be replaced	CV number	Replacement type
212K		MW53-80
213P		R142
213Pen		PL81;21A6
272		PL5557
287A		PL5557
309		PL5557
311SU		UY41;31A3
323A,323B		(PL3C23)
328		328
329		329
340		340
367	2634	367
393A		(PL3C23)
417A	2642	417A;5842
451		451
451PT		UL41;45A5
460BU	2644	1561
502A		(PL2D21);(PL5727); (M8204)
575A		(7136);(DCG6/18GB)
631		PL5559
651		ZX1052
652		ZX1051
653B		ZX1055
655		ZX1053 (ZX1063)
656		ZX1052
657		ZX1051
673		(6693);(DCG6/18)
676		(PL105)
682		ZX1060
686		ZX1060
710		PL5684/C3JA
715		PL5557
723A/B	1795	723A/B
725A	722	725A

Type to be replaced	CV number	Replacement type
813	26	813;QB2/250
816	724	(866A);(DCG4/1000G)
829B		(5984);(QQE06/40)
832		832A;QQE04/20
832A	788	832A;QQE04/20
833A		833A;(TB4/1250)
857B		(6786);(DCG7/100B)
866		866A;DCG4/1000G
866A	32	866A;DCG4/100G
866B		(866A);(DCG4/1000G)
868	2680	(3554)
869;869A		(6508);(DCG9/20)
869B	2723	(6508);(DCG9/20)
872		872A;DCG5/5000GB
872A	642	872A;DCG5/5000GB
872B		ZY1000
873		(DCG6/6000)
884		(PL2D21);(PL5727); (M8204)
885		(PL2D21);(PL5727); (M8204)
912NB4		912NB4
918		(3554)
927		(3546PW)
966		866A;DCG4/1000G
967		PL5557
1010		1010
1018		1018
1037		1037
1038		1038
1039		1039
1040		1049
1054		1054
1069K		1069K
1081		ZX1061

Type to be replaced	CV number	Replacement type
1110		1110
1119		1119
1129		1129
1138		1138
1163	1836	1163
1164		1164
1173		1173
1174		1174
1176		1176
1177		1177
1257		PL5559
1267		PL1267/Z300T
1319		(XQ1030)
1320		(XQ1030)
1331		1331
1607		PL1607
1625		(PE06/40E)
1701		PL5557
1710		1710
1725A		1725A
1738		1738
1749A		1749A
*1759		1859 + 1289
1788		1788
1838		1838
1849		1849
1859		1859
1875		1875
1876	2718	1876
1877	1134	1877
1878		1878
1904H		1904H

Type to be replaced	CV number	Replacement type
1905		1905
1908		1908
*1909		1909H
1909H		1909H
1910		1910
1923		1923
1927		1927
1928		1928
1941A		1941A
2000		1163
2100A		8020
2183		1164
2255AMR		XQ1054
2255IND		XQ1053
2255NOR		XQ1052
2255ROE		XQ1051
2255FIM		XQ1050
3069		866A;DCG4/1000G
3070		872A;DCG5/5000GB
3078A		(6508);(DCG9/20)
3530		3530
3533A		3533A
*3534		3534
3538		3538
*3541		3533A
3545		3545
3545PW		3545PW
3546		3546
3546PW		3546PW
3554		3554
3572		866A;DCG4/1000G
3861B		QEL1/150;4X150A
3874A		QB2/250;813
3885A		3B28;DCX4/1000
4049D		(DCG4/5000)

* Obsolete type with replacement type

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Type to be replaced	CV number	Replacement type
4065	495	4065
4066	2730	4066
4067		4067
4068	2348	4068
4069		4069
4070		4070
4078A		(DCG9/20);(6508)
4078GA		(DCG9/20);(6508)
4078Z		(DCG9/20);(6508)
4152/02		4152/02
4260		PL5557
4261		PL5557
4349		4349
4369		4369
4370		4370
4371		4371
4372		4372
*4373		4369
4378		4378
4379		4379
4390		4390
4397		4397
4438		(XP1011)
4439		(XP1011)
4440		XP1011
4441		(XP1011)
4459		(56TVP)
4460		(XP1115); (XP1111)
4461		(XP1011)
4463		(XP1002)
4478		(XQ1030)
4488		(XQ1030)
4503		(XQ1053)
4591		55875
4592		(XQ1020)
4613		4613
4641		4641
4646		4646
*4648		DCG1/250; DCG4/1000G;866A
*4649		DCG4/1000ED
4659		4659
4662		4662
5021B		DCG4/1000G;866A
5031		DCG5/5000GB;872A
5121		DCX4/1000;3B28
5544	2210	PL5544
5545	2215	PL5545
5550		(ZX1060)
5551		ZX1051
5551A		ZX1051
5552		ZX1052
5552A		ZX1052
5553		ZX1053;(ZX1063)
5553A		ZX1053;(ZX1063)
5553B		ZX1053
5555		ZX1055
5555A		ZX1055
5557	2957	PL5557
5559		PL5559
5586	3611	5586
5632		PL5632;C3J
5636	3928	5636;EF730
5639	2662	5639
5641		5641
5642	2241	5642;DY70
5643	5079	5643
5644	3987	5644
5651	2573;5186	5651;M8098

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
5654	4010;5216	5654;E95F; 6AK5W;M8100
5672	2238	5672
5678	2254	5678;DF60
5684		PL5684/C3J/A
5696	3512	5696;EN92
5718	3930	5718;EC71
5719	4008	5719
5725	4011	5725;6AS6W
5726	4007;5189	5726(E91AA); (6AL5W);(M8212)
5727	4018	PL5727;M8204
5749	4009	5749;6BA6W
5751	4017	5751
5762		(YD1120)
5763	2129	5763;QE03/10;M8096
5771		5771
5783		5783WA;M8190
5783W	3960;3933 4066	5783WA;(M8190)
5819		(XP1000)
5822		ZX1061
5822A		ZX1061
5823		5823;Z900T
5840	3929	5840;EF732
5842	3789	5842;417A
5847	3905	5847;E182F
5855		5855;XR1-12
5861		5861;EC55
5866	1924	5866;TB2.5/300
5867	1350	5867;TB3/750
5868	1351	5868;TB4/1250
5869		5869;(DCG6/6000)
5870		5870;DCG12/30
5876		5876
5876A		5876A
5893		5893
5894	2797	5894;QQE06/40
5895	1838	5895;QQC04/15
5899	475;477	5899;(EF731)
5902	4029	5902
5920	5214	5920;E90CC
5923		5923;TBW6/6000
5924	3926	5924;TBL6/6000
5949	3521	5949
5949A		5949A
6007		6007;DL67
6008		6008;DF67
6011		(PL5684/C3JA)
6021	3986	6021;(ECC70)
6027H		YJ1060
6057		(M8137)
6058	4025	(M8079)
6060		M8162
6062	4039	6062
6064	4014	M8083
6065	4015	M8161
6067		M8136
6073	2903	M8223
6074		M8224
6075		6075;QBW5/3500
6076	5219	6076;QBL5/3500
6077		6077;TBW12/100
6078		6078;TBL12/100
6079	3522	6079;QB5/1750
6080	2984	6080
6083		6083;PE1/100
6084	2729	6084;E80F
6085		6085;E80CC
6086		6086;18042

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Type to be replaced	CV number	Replacement type
6096	4010;5216	5654;E95F; 6AK5W;M8100
6097	4007	5726;E91AA; 6AL5W;M8212
6097B		XP1000
6097F		(XP1001)
6097G		(XP1000)
6099		M8081
6100	4058	M8080
6101	4031	M8081
6111		6111
6112		6112
6135	4022	M8080
6146	3523	6146;QE05/40
6146A		6146A;QE05/40
6146B		6146B;YL1370
6155	2130	6155;QB3/300
6156	2131	6156;QB3.5/750
6159		6159;QE05/40H
6159A		6159A;QE05/40H
6159B		6159B;YL1372
6187		M8196
6189	4003	6189;12AU7WA; M8136;E82CC
6198/A		(XQ1053)
6199		150AVP
6201	4024;3508; 5212	6201;E81CC; 12AT7WA;M8162
6205	2432	6205;EF734
6206		6206
6211		6211
6218		6218;E80T
6227		6227;E80L
6252	2799	6252;QQE03/20
6255B		(56AVP/05)
6255G		(56UVP)
6255S		(56AVP/03)
6263		6263
6263A		6263A
6264		6264
6264A		6264A
6267	2901	6267;EF86;M8195
6268	1787	6268;4C35A
6279	2520	6279;5C22
6286		6286
6291		150AVP
6292		6292
6293		6293
6308		(ZZ1000)
6334		56032
6342A		XP1001
6346		(ZX1051)
6347		(ZX1052)
6348		(ZX1053)
6354	2225	6354;150B2; M8163
6360;6360A	2798	6360;QQE03/12
6362		XP1111;(XP1110)
6363		XP1030
6364		(54AVP)
6365		(XP1113)
6370	5106	6370;E1T
6373	2105	6373;DL70
6375	2275	6375;DC70
6443	4044	M8091
6463	5304	6463
6467		150AVP;(XP1180)
6476		Z502S
6489	469	6489;EA76
6508		6508;DCG9/20

Type to be replaced	CV number	Replacement type
6511		(ZX1061)
6524		(6252);(QQE03/20)
6538		6538;Z800U
6539		6539;Z80IU
6574	2253	PL6574
6587		(5C22);(6279)
6617		6617;TBW12/25
6618		6618;TBL12/25
6626		M8223
6627		M8224
6655A		XP1000
6681		6681;E83CC
6686		6686;E81L
6688	3998	6688;E180F; (E136F);(7737)
6689		6689;E83F
6693		6693;DCG6/18
6700	5277	6700;ET51
6755		PL6755
6778		6778;EC70
6779	2434	6779;Z803U
6786		6786;DCG7/100B
6807		PL6807
6810A		(56AVP);(56AVP/05)
6810B		(56AVP);(56AVP/05)
6816		6816;YL1101
6844A		ZM1020
6850		(6252);(QQE03/20)
6883		6883;QE05/40F
6883A		6883A;QE05/40F
6883B		6883B;YL1371
6884		6884;YL1100
6894		(7136);(DCG6/18GB)
6895		(6693);(DCG6/18)
6903		XP1004
6907		6907
6911		XP1005
6922	2492	6922;E88CC; (E188CC);(7308)
6923	5140	6923;EA52
6935		XP1111;(XP1110)
6939		6939;QQE02/5
6960		6960;TBW7/8000
6961		6961;TBL7/8000
6972		6972
6977		6977;DM160
7004		7004;TBL2/300
7008		7008;YJ1010
7025		7025;12AX7S;M8137
7028		7028
7034		4X150A;QEL1/150
7035		4X150D;QEL1/150H
7038		(XQ1050)
7038A		(XQ1040);(XQ1050)
7046		(58AVP);(XP1040)
7062		7062;E180CC
7064		XP1000
7065		150AVP
7088		YJ1030
7090		7090
*7091		YJ1162
7092		7092;TB5/2500
7093		7093
7102		150CVP
7111		YJ1011
7119	5188	7119:E182CC
7136		7136;DCG6/18GB
7189		7189
7203		4CX250B;QEL2/275
7204		4CX250F; QEL2/275H

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
7237		(TBL7/8000);(6961)
7247		7247
7262		(XQ1042);(XQ1043)
7262A		(XQ1030);(XQ1042); (XQ1043)
7264		(56AVP);(56AVP/05); (56AVP/SP)
7265		(56TVP)
7289		7289
7291/A		(XQ1040);(XQ1050)
*7292		YJ1160
7308	5231;4108	7308;E188CC
7316		7316;ECC186
7320		7320;E84L
7326		XP1002
7336		(XQ1040)
7351		(XW1050)
7377		7377;QQE04/5
7378		7378;QE08/200
7386		PL5545A
7459		(YD1120)
7475	1070	7475
7522		(XQ1010)
7527		7527;QB4/1100; YL1460
7534		7534;E130L
7537		7537
7580		7580;QEL2/200
7580W		YL1170;4CX250R
7609		7609
7632		7632;ORP10
7634		7634;61SV
7643		7643;E80CF
7645		(6939);(QQE02/5)
7650		7650;YL1110
7664		XP104
7681		(ZX1062)
7693		7693;E90F
7694		7694;E99F
7696		XP1001
7697		(XQ1052);(XQ1053)
7704		7704;QBL5/4000
7709		7709
7710		7710;Z70U
7711		7711
7714		7714;Z805U
7721		D3a
7722		7722;E280F
7735A,B		(XQ1052);(XQ1053)
7737		7737;E186F
7746		(XP1001)
7751		7751;E235F
7753		7753;TBL6/4000
7764		(XP1113)
7767		XP1111;(XP1110)
7788		7788;E810F
7800		(TBL12/40)
7804		7804;TBL6/14
7805		7805;TBW6/14
7806		7806;TBL12/38
7807		7807;TBW12/38
7817		XP1000;(XP1001)
7818		XP1030;(XP1031)
7819		(54AVP)
7836		7836;QE08/200H
7843		YL1102;7843
7844		YL1103;7844
7850		(56AVP);(56AVP/05)
7854		7854;YL1060
7860		(XP1115)

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
7899		7899
7908		(XP1115)
7909		(XP1110);(XP1111)
7980		7980;83A1
7981		PL7981
7983		7983;QQC03/14
7986		7986;TB2.5/400
8008		8008;DCG5/5000GS
8008A		ZY1001
8020	2967	8020
8032		8032;QE05/40K
8032A		8032A;YL1371
8042		8042;QC05/35
8053		XP1001;(XP1000)
8054		XP1031;(XP1030)
8055		54AVP
8062		150CVP
8063	5234	PL5684/C3JA
8078		8078;TB4/1500
8108	5397	8108;EC157
8116		8116;YL1071
8117		8117;YL1070
8118		8118;YL1020
8119		8119;TBL2/400
8120		8120;TBL2/500
8163		8163;YD1130
8165		8165;QB3/200
8177		8177;QBL3.5/2000
8179		8179;QB5/2000
8223		8223;E288CC
8228		8228;ZZ1000
8233		8233;E55L
8253/6587A		(5C22);(6279)
8254		8254;EC1000
8255		8255;E88C
8268		8268;TBW7/9000
8269		8269;TBL7/9000
8270		ZT1000
8278		8278;EL503
8298A		8298A;YL1370;6146B
8321		8321;YL1340
8322		8322;YL1341
8348		8348;YL1080
8356		(YJ1040)
8408		8408;YL1130
8421		(ZM1020)
8429		8429;YL1120
8436		8436;EC158
8438		8438;QB4/1100GA; YL1461
8438A		8438A;YL1461
8453		8453;ZM1050
8457		8457;YL1210
8458		8458;YL1240
8463		8463;YL1000
8482		ZT1001
8483		(XQ1030);(XQ1040)
8484		(XQ1052);XQ1053)
8505		8505;YL1250
8507		(XQ1050);(XQ1052)
8511		(XQ1030)
8541		XQ1040;XQ1042
8552		8552;YL1371
8560		8560;UL1320
8566		(XQ1040);(XQ1050)
8572		(XQ1040);(XQ1050)
8573		XQ1040

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Type to be replaced	CV number	Replacement type
8577		8577;YL1220
8579		8579;YL1150
8580		8580;YL1190
8591		8591;TBH6/14
8592		8592;TBH7/8000
8593		8593;TBH7/9000
8594		8594;TBH12/38
8604		55851S
8610		8610;TBH6/6000
8621		8621;4CX250FG
8625		(XQ1050);(XQ1052)
8626		(XQ1040);XQ1042
8628		(55851)
8637		8637;YL1300
8654		8654;YL1230
8666		8666;YD1170
8667		8667;YD1171
8668		8668;YD1172
8679		8679;YL1121
8680		8680;YD1212
8683		8683;YL1360
8728		8728;YD1150
8729		8729;YD1151
8730		8730;YD1152
8731		8731;YD1160
8732		8732;YD1161
8733		8733;YD1162
8734		8734;YD1173
8735		8735;YD1182
8736		8736;YD1192
8744		8744;YL1330
8752		8752;YD1202
8801		8801;YD1180
8812		8812;YL1420
8813		8813;YL1430
8814		8814;YL1440
8867		8867;YD1352S
8888		8888;YL1470
8913		8913;YD1195
8915		8915;YL1520
8918		8918;YD1342
8928		8928
8935		8935;YD1185
8936		8936;YD1187
8937		8937;YD1197
9514B		(56AVP);(56AVP/05)
9514S		(56AVP/03)
9524B		(XP1180)
9530B		(54AVP)
9530Q		(54UVP)
9531A		(XP1031)
9531B		(XP1030)
9536B		XP1001
9545B		(57AVP)
9552B		XP1004
9553		XP1005
9558B		(XP1002)
9578B		XP1030
9578U		(XP1030)
9578X		XP1030
9579B		(54AVP)
9579U		(54AVP)
9583B		54AVP
9584B		53AVP;(XP1000)
9584X		53AVP;(XP1000)
9593B		(56AVP);(56AVP/05)
9594B		(56AVP);(56AVP/05)
9601B		(XP1180)
9607B		(XP1002)
9609		(XP1110);(XP1111)

Type to be replaced	CV number	Replacement type
9618B		(54AVP)
9623B		(57AVP)
9677		XQ1042;XQ1043
9728		XQ1052;XQ1053
9745		(XQ1010)
10667F		(XQ1050)
10667G		(XQ1053)
10667M		(XQ1054)
10667S		(XQ1052)
10667SC		(XQ1050)
10667T		(XQ1052)
13201A		13201A
13201E		13201E
16907		16907
18014		18014
18042		18042;6086
18045		18045
18503		18503
18504		18504
18505		18505
18506		18506
18507		18507
18509		18509
18511		18511
18515		18515
18515/01		18515/01
18516		18516
18518		18518
18520		18520
18524		18524;(ZP1082)
18525		18525;(ZP1072)
18526		18526
18529		18529
18533		18533;(ZP1083)
18536		18536
18536/01		18536/01
18537		18537
18538		18538
18545		18545
18546		18546
18550		18550
18552		18552
18553		18553
18600		18600
18600R		18600R
18601		18601
18602		18602
18603		18603
18700		18700
38116		1163
38166		866A;DCG4/1000G
38172		872A;DCG5/5000GB
55029		55029
55030		55030
55031/01		55031/01
55031/02		55031/02
55032/01		55032/01
55032/02		55032/02
*55035		2J42
*55040		725A
*55125		YJ1191
*55230		5J26
55305		55305
55306		55306
55335		55335
55340		55340
*55370		YK1010
*55390		2K25
*55391		723A/B
*55850AM		(XQ1044)
*55850F		(XQ1040)

* Obsolete type with replacement type

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Type to be replaced	CV number	Replacement type
*55850N		(XQ1043)
*55850S		(XQ1042)
*55850SR		(XQ1041)
*55851AM		XQ1044
*55851F		XQ1040
*55851N		XQ1043
*55851S		XQ1042
*55851SR		XQ1041
*55852AM		XQ1054
*55852F		XQ1050
*55852N		XQ1053
*55852S		XQ1052
*55852SR		XQ1051
55875		55875
55875B		55875B
55875G		55875G
55875L		55875L
55875R		55875R
55875-IG		55875-IG
55875B-IG		55875B-IG
55875G-IG		55875G-IG
55875R-IG		55875R-IG
55876/01		55876/01
*56000		8020
56001		56001
56006		56006
56032		56032
56050-01		56050-01
56054		56054
56055		56055
56056		56056
56057		56057
62019		62019
62022		62022
62028		62028
62031		62031
68506	2775	1163
68508		1164
95108		95108
95322		95322
*95398		—
178148		1163
178149		1163
180238		1164
189048		1163
189049		1163
217283		1164
289414		1163
289416		1163
766776		1164
A28-13W		A28-13W
A28-14W		A28-14W
A31-20W		A31-20W
A31-120W		A31-120W
A31-410W		A31-410W
A44-120W		A44-120W
*A47-11W		A47-26W
A47-13W		19CWP4
A47-14W		A47-14W
A47-15W		19CWP4
A47-17W		A47-26W
A47-18W		A47-26W
A47-26W		A47-26W
A50-120W		A50-120W
A56-120X		A56-120X

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
A56-140X		A56-140X
A59-11W		A59-11W
A59-12W		A59-11W
A59-13W		A59-16W
A59-14W		A59-16W
A59-15W		A59-15W
A59-16W		A59-16W
A59-23W		A59-23W
A61-120W		A61-120W
A63-11X		A63-120X
A63-120X		A63-120X
A65-11W		A65-11W
A66-120X		A66-120X
A66-140X		A66-140X
A4051		QE06/50;807
AA91E		5726;E91AA; 6AL5W;M8212
ACS4		QBL5/3500;6076
ACT70		YD1120
ACT100		(TBL6/14);(7804)
AG3B28	1835	DCX4/100;3B28
AG575A		(DCG6/18GB);(7136)
AG866A	32	DCG4/1000G;866A
AG869B		(DCG9/20);(6508)
AG872A	642	DCG5/5000GB;872A
AG5004		(DCG4/1000G);(866A)
AG5005		(DCG7/100)
AG5006		(DCG6/18);(6693)
AG5209		85A2;OG3;M8098
AG5210		OB2;OB2WA;M8224
AG5211		OA2;150C2; OA2WA;M8223
AG8008		DCG5/5000GS;8008
AGR9950		5869;(DCG6/6000)
AGR9951		5870;DCG12/30
AH201		(886A);(DCG4/1000G)
AH205		(DCG7/100)
AH213		(DCG9/20);(6508)
AH217		DCG5/5000GB;872A
AH221	5	(DCG4/5000)
AH238		DCG4/5000
AJ5551		ZX1051
AJ5551A		ZX1051
AJ5552		ZX1052
AJ5552A		ZX1062
AJ5553A		ZX1053
AJ5553B		ZX1053;(ZX1063)
AJ6346		(ZX1051)
AJ6347		(ZX1052)
APY16		APY16
APY17		APY17
APY18		APY18
APY19		APY19
APY21		APY21
APY22		APY22
APY23		APY23
APY24		APY24
APY41		APY41
APY42		APY42
APY43		APY43
APY44		APY44
APY45		APY45
APY46		APY46
APY56		APY56
APY57		APY57
APY58		APY58
APY59		APY59
AR10		(ZX1052)
AR10T		(ZX1052)
AR14		ZX1051

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Type to be replaced	CV number	Replacement type
AR14T		(ZX1051)
AR14TP		(ZX1051)
AR14TWS		(ZX1051)
ART10TP		(ZX1052)
ART10TWS		(ZX1052)
ASG5007		(DCG12/30);(5870)
ASG5017		PL5557
ASG5023		PL3C23
ASG5044B		PL6755
ASG5045B		PL106
ASG5121		PL2D21;EN91; PL5727;M8204
ASG5155A		(PL255)
ASG5544		PL5544
ASG5545		PL5545
ASG5696		5696
ASG5727		PL5727;M8204
ASG5823		5823;Z900T
ASG5830		(DCG7/100)
ASG6011		PL5684/C3JA
ASG6574		PL6574
ASG6807		PL6807
ATS25		807;QE06/50
AVHC41		AVHC41
AVHC201		AVHC201
*AW21-10		M21-11W
AW36-20		AW36 20;14ABP4A
AW36-21		AW36-21;14ABP4
AW36-81		AW36-81;14AHP4
AW43-88		AW43-88
AW47-12		(AW47-91)
AW47-30		(AW47-91)
AW47-90		AW47-91
AW47-91		AW47-91
AW47-94		AW47-91
AW47-97		(AW47-91)
AW53-80Z		AW53-80Z
AW53-88		AW53-88
AW53-89		AW53-89
AW59-90		AW59-90:23CMP4
AW59-91		AW59-91
AW61-88		AW61-88
AX3C23		PL3C23
AX4-125A	2130	6155;QB3/300
AX4-250A	2131	6156;QB3.5/750
AX105		PL105
AX195		AX195
AX224	1835	DCX4/1000;3B28
AX228		(DCX4/5000);(4B32)
AX230	2518	DCX4/5000;4B32
AX5551		ZX1051
AX5551A		ZX1051
AX5552		ZX1052
AX5552A		ZX1052
AX5553		ZX1053
AX5553B		ZX1053
AX5555		ZX1055
AX5822		ZX1061
AX5822A		ZX1061
AX7585		ZX1052
AX9900		5866;TB2.5/300
AX9901		5867;TB3/750
AX9902		5868;TB4/1250
AX9903	2797	5894;QQE06/40
AX9904		5923;TBW6/6000
AX9904R		5924;TBL6/6000
AX9905		5895;QQC04/15
AX9906		6077;TBW12/100
AX9906R		6078;TBL12/100

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
AX9907		6075;QBW5/3500
AX9907R		6076;QBL5/3500
AX9908		6079;QB5/1750
AX9909		6083;PE1/100
AX9910		6252;QQE03/20
AX9911		4C35A;6268
AX9912		5C22
AZ41	3892	AZ41
B6H		(18533);(ZP1083)
B109		UCC85
B142	1927	(TB4/1250);(5868)
B152		ECC81;12AT7
B309		ECC81;12AT7
B310 .. series		B310 .. series
B312 .. series		B312 .. series
B318 .. series		B318 .. series
B329		ECC82;12AU7
B330 .. series		B330 .. series
B339		ECC83;12AX7
B410 .. series		B410 .. series
B419 .. series		B419 .. series
B719		ECC85;6AQ8
B1135		TB3/750;5867
B1152		TB4/1500
B1153		TB5/2500
B5030		ZM1030
B5031		Z520M
B5032		Z521M
B5092		(ZM1020)
B5441		(ZM1000)
BF61		EL41;6CK5
BF62		EL42
BF451		UL41;45A5

Type to be replaced	CV number	Replacement type
BK24		ZX1052
BK24A		(ZX1052)
BK24B		(ZX1052)
BK24C		ZX1052
BK34		ZX1063
BK34A		(ZX1063)
BK34B		(ZX1063)
BK42		ZX1051
BK42A		ZX1051
BK42B		(ZX1051)
BK42C		ZX1051
BK46		ZX1055
BK66		(ZX1060)
BK146		ZX1053;ZX1063
BK168		(ZX1061)
BK168B		(ZX1061)
BK542		ZX1061
BM1002		JP9-15B
BM1048		YJ1110
BM1049		2J42
BMQ10/14		(XP1118)
BMS10/14		(XP1110)
BMS11/23		(XP1180)
BPX10		BPX10
BPX12		BPX12
BPX13		BPX13
BPX14		BPX14
BPX52		BPX52
BPX56		BPX56
BPX57		BPX57
BPY20		BPY20
BPY22		BPY22
BPY23		BPY23
BPY24		BPY24
BPY51		BPY51

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Type to be replaced	CV number	Replacement type
BPY52		BPY52
BPY53		BPY53
BPY54		BPY54
BPY55		BPY55
BPY56		BPY56
BPY57		BPY57
BPY58		BPY58
BPY59		BPY59
BPY75-300		BPY75-300
BPY81		BPY81
BPY82		BPY82
BPY83		BPY83
BPY84		BPY84
BPY85		BPY85
BPY86		BPY86
BPY87		BPY87
BPY88		BPY88
BPY89		BPY89
BR191B		YD1120
BR1126		YD1230
BR1162		TBL7/8000
BR1165		TBL6/6000
BT5		PL5559
BT17		(PL105)
BT19		(PL5557)
BT29		PL255
BT69		(DCG7/1000B);(6786)
BT77		PL5545A
BT79		(3C45)
BT91		PL5544
BTW6-3		(TBW6/14)
BW1162		TBW7/8000
BW1162J3		TBH7/8000
BW1165		TBW6/6000
BW1165J3		TBH6/6000
C3J		PL5632/C3J
C3JA		PL5684/C3JA
C3m	5232	C3m
C6A		(PL5545A)
C6J		PL5545A
C6JA		(PL5545A)
C6L		(PL5545A)
C6M		(PL5545A)
C6P		(PL5545A)
C21AA		(AW53-88)
C21KM		(AW53-80);(21CPL4)
C102A		XQ1053;XQ1054
C102B		XQ1043;XQ1044
C103A		XQ1052
C103B		XQ1042
C104A		XQ1050
C104B		XQ1040
C143	26	QB2/250;813
C144	2666	(QQE06/40);(5894)
C178A		QQE06/40;5894
C180	788	QQE04/20;832A
C350		(QE06/50);(807)
C866A		DCG4/1000G;866A
C872		DCG5/5000GB;872A
C1108		QB3/300;6155
C1112		QB3.5/750;6156
C1134		QQE03/20;6252
C1136		QB4/1100;7527
C9132		(XQ1053)
C9132A		XQ1053

Type to be replaced	CV number	Replacement type
C9133		(XQ1050);(XQ1052)
C9133A		XQ1050;XQ1052
C9138		(XQ1054);XQ1030
C9138A		XQ1054
CC81E		12AT7WA;E81CC; 6201;M8162
CC86E		6463
CCa		E88CC;6922
CD18		ZM1020
CD26		ZM1020
CD64		ZM1080
CE225		1163
CE226		1163
CE235		1164
CE305		(PL5557)
CE306		(PL5545A)
CE308		(PL105)
CE309		PL5557
CE311		PL3C23A
CE866A		DCG4/1000G;866A
CE872A		DCG5/5000GB;872A
CE5685/CJ6		PL5545A
CK1084		(ZM1080)
CK5651	3573;5186	5651;M8098
CK5654	4010;5216	5654;E95F; 6AK5W;M8100
CK5672	2238	5672
CK5678	2254	5678;DF60
CK5725	4011	5725;6AS6W; M8196
CK5726	4007;5189	5726;E91AA; 6AL5W;M8212
CK5783		5783WA;M8190
CK6021	3986	6021;ECC70
CK8650		(ZM1000)

Type to be replaced	CV number	Replacement type
CL1002		(XP1000)
CL1003		XP1030
CL1005		150CVP
CL1006		XP1005
CL1008		(XP1004)
CL1009		XP1032
CL1012		150AVP
CL1015		(56AVP)
CL1090		(56AVP);(56AVP/05)
CME1901		(AW47-91)
CME1902		AW47-91
CME1903		AW47-91
CME1906		19CWP4
CME2301		AW59-90;23CMP4
CME2302		AW59-90;23CMP4
CME2303		AW59-91
CQL/03-1		QEL2/275
CR1100	5219	QBL5/3500;6076
CRY1		CRY1
CRY2		CRY2
CRY3		CRY3
CRY4		CRY4
CRY101		CRY101
CRY103		CRY103
CRY104		CRY104
CST2/12		(PL255)
CT1/2500		PL5559
CW1100		QBW5/3500;6075
D2M9		EAA91;6AL5; 6AL5W;(E91AA); 5726
D3a		7721
D7-190..		D7-190..

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Type to be replaced	CV number	Replacement type
D10-11..		D10-11..
D10-12..		D10-12..
D10-160..		D10-160..
D10-161..		D10-161..
D10-170..		D10-170..
D10-200..		D10-200..
D13-15..		D13-15..
D13-16..		D13-16..
D13-16../01		D13-16../01
D13-19..		D13-19..
D13-21..		D13-21..
D13-26..		D13-26..
D13-26../01		D13-26../01
D13-27..		D13-27..
D13-450../01		D13-450../01
D13-480..		D13-480..
D13-481..		D13-481
D13-500../01		D13-500../01
D14-120..		D14-120..
D14-121..		D14-121..
D14-122..		D14-122..
D14-123..		D14-123..
D14-160../09		D14-160../09
D18-120..		D18-120..
D77		EAA91;6AL5
D152		EAA91;6AL5
DA90	753	DA90;1A3
DC70	2275	DC70;6375
*DC80		DC70;6375
DCG1/250		DCG1/250
DCG1.5/250		DCG1.5/250
DCG2/500		DCG2/500
DCG4/1000A		DCG4/1000A;866A
DCG4/1000ED	1625	DCG4/1000ED
DCG4/1000G	32	DCG4/1000G;866A
DCG4/5000	1629	DCG4/5000
DCG5/5000EG		DCG5/5000EG; ZY1002
DCG5/5000GB	642	DCG5/5000GB;872A; ZY1000
DCG5/5000GS		DCG5/5000GS;8008; ZY1001
DCG6/18		DCG6/18;6693
DCG6/18GB		DCG6/18GB;7136
DCG6/6000		DCG6/6000;(5869)
DCG7/100		DCG7/100
DCG7/100B		DCG7/100B;6786
DCG9/20		DCG9/20;6508
DCG12/30		DCG12/30;5870
DCX4/1000	1835	DCX4/1000;3B28
DCX4/5000	2518	DCX4/5000;4B32
DD6		EAA91;6AL5
DDB47		Z806W
DDB52		Z302C
DDB70		Z504S
DDPP39S		CBL1
*DE2/200		DCG1/250; DCG4/1000G;866A
DET22	273	TD83-10
DET22G		EC55;5861
DF60	2254	DF60;5678
DF61N	2371	DF61N
DF63	2433	DF63
DF67		DF67;6008
DF72	2101	DF72
DF73	2103	DF73
*DG7-1		DG7-5;3ALP1
*DG7-2		DG7-6
*DG7-3		DG7-5;3ALP1
*DG7-4		DG7-6

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
DG7-5	2175	DG7-5;3ALP1
DG7-6	5269	DG7-6
DG7-31		DG7-31
DG7-32		DG7-32;3AMP1A
DG7-36	3946	DG7-36;3WP1
DG10-2		DG10-2
DG10-3		DG10-3
DG10-6		DG10-74
DG10-74		DG10-74
DG13-2	2191	DG13-2
DG13-32		DG13-32
DG13-34	5035	DG13-34;5ADP1
*DG13-78		D13-21GH
DH3-91	2302	DH3-91;1CP31
DH7-11		DH7-11;3BYP31
DH7-78		DH7-78;3B P31
*DH7-91		DH7-11
DH10-78		DH10-78
*DH10-94		DH10-78
*DH13-76		D13-15GH;5CBP31
DH13-78		DH13-78;5BHP31
*DH13-79		D13-21GH
DH63	587	6Q7G
DH63(Met)		6Q7GT
DH77	452	EBC90;6AT6
DH109		UABC80
DH118		UBC41;14L7
DH119		UBC81
DH142		UBC41;14L7
DH150		EBC41;6CV7
DH718		EBC41;6CV7
DH719		EABC80;6AK8
*DHM10-93		E10-12GH
DL64	2331	DL64
DL67		DL67;6007
DL68		DL68
DL69	2361	DL69
DL70	2105	DL70;6373
DL96		DL96;3C4
DL620	2238	5672
DL652		DL69
DM70	2980	DM70;1M3
DM71		DM71;1N3
DM160		DM160;6977
*DN7-1		DG7-5;3ALP1
*DN7-2		DG7-6
*DN7-3		DG7-5;3ALP1
*DN7-4		DG7-6
*DN7-5		DG7-5;3ALP1
DN7-11		DN7-11;3BYP2
DN7-36		DN7-36;3BWP2
DN7-78		DN7-78;3BKP2
*DN9-4		DN10-78;DH10-78
*DN9-5		DG10-5
*DN10-5		DG10-5
*DN10-6		DG10-6
DN10-78		DN10-78
*DN10-94		DN10-78
DN13-34		DN13-34;5ADP2
*DN13-76		D13-15GP
*DN13-78		D13-21GP
*DN13-79		D13-21GP
*DNM10-93		E10-12GP
DP7-5	5171	DP7-5;3ALP7
DP7-6		DP7-6
DP7-11		DP7-11
DP7-36		DP7-36;3WP7
DP7-78		DP7-78
*DP7-91		DP7-11
DP10-106		DP10-6

* Obsolete type with replacement type

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Type to be replaced	CV number	Replacement type
*DP10-78		DN10-78
*DP10-94		DN10-78
DP13-2		DP13-2
DP13-34		DP13-34;5ADP7
*DP13-76		D13-15GM
*DP13-78		D13-21GM
*DP13-79		D13-21GM
DP61		EF95;6AK5
*DPM10-93		E10-12GM
DQ2		DCG4/1000G;866A
DQ2a		DCG4/1000ED
DQ4		DCG5/5000GB;872A
DQ4a		DCG5/5000EG
DQ5		(DCG6/18);(6693)
DQ5B		(DCG6/18GB)
DQ5C		(DCG6/18)
DQ6		(DCG9/20);(ZT1000)
DQ7		(DCG7/100B);(6786)
DQ45		(ZY1000)
*DR7-3		DG7-5
*DR7-4		DG7-6
DR7-5		DG7-5
DR7-6		DG7-6
DR10-6		DG10-6
DR13-2		DG13-2
DR869B		(6508);(DCG9/20)
DX2		DXC4/1000;3B28
DX144		EC157;8108
DX145		EC157;8108
DX145A		EC157;8108
DX151		YK1010
DX155		7093
DX184		55335
DX206		DX206
DX267		DX267
DX274		8603;YL1310
DX276		DX276
DX285		YJ1180
DX290		YJ1320
DY51		DY51;1BG2
DY70	2241	DY70;5642
DY86 } DY87 }		DY87;DY802
DY802		DY802;1BQ2
E1T	5106	E1T;6370
E10-12GH		E10-12GH
E10-12GM		E10-12GM
E10-12GP		E10-12GP
E10-130GH		E10-130GH
E10-130GM		E10-130GM
E10-130GP		E10-130GP
E14-110GH		E14-110GH
E55L		E55L;8233
E80CC		E80CC;6085
E80CF		E80CF;7643
E80F	2729	E80F;6084
E80L		E80L;6227
E80T	5724	E80T;6218
E81CC	4024;5212; 3508	E81CC;6201; (12AT7WA);(M8162)
E81L		E81L;6686
E82CC		E82CC;6189
E83CC		E83CC;6681
E83F		E83F;6689

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
E84L		E84L;7320
E86C		E86C
E88C		E88C;8255
E88CC	2492	E88CC;6922
E90CC	5214	E90CC;5920
E90F		E90F;7693
E91AA	4007;	E91AA;5726; (6AL5W);(M8212)
E91N	4018	PL5727;M8204
E92CC		E92CC
E95F	4010;5216	E95F;5654; (6AK5W);(M8100)
E99F		E99F;7694
E125A		QB3/300;6155
E130L		E130L;7534
E180CC		E180CC;7062
E180F	3998	E180F;6688
E182CC	5188	E182CC;7119
E182F		E182F;5847
E186F		E186F;7737
E188CC	5231;4108	E188CC;7308
E235F		E235F;7751
E235L		E235L
E236L		E236L
E250A		QB3.5/750;6156
E280F		E280F;7722
E282F		E282F
E283CC		E283CC
E288CC		E288CC;8223
E810F		E810F;7788
E1485	807	DL93;3A4
E1955	797	PL2D21;EN91; PL5727;E91N;M8204
E2016		EF92;6CQ6;M8161
E2157	455	ECC81;12AT7
E2163	491	ECC82;12AU7
E2164	492	ECC83;12AX7
EA52	5140	EA52;6923
EA53		EA53
EA76	469	EA76;6489
EAA91	283	EAA91;6AL5
EAA901		E91AA;5726 (6AL5W);(M8212)
EAA901S		E91AA;5726;6AL5W
EABC80		EABC80;6AK8
EAF42	3883	EAF42;6CT7
EAF801		EAF801
EB91	140	EAA91;6AL5
EBC41	3882	EBC41;6CV7
EBC80		EBC80;6BD7
EBC81		EBC81;6BD7A
EBC90	452	EBC90;6AT6
EBC91	2526	EBC91;6AV6
EBF80		EBF80;6N8
EBF83		EBF83;6DR8
EBF89		EBF89;6DC8
EBL21		EBL21
EC50	2927	EC50
EC52		EC52
EC54		EC54
EC55		EC55;5861
*EC56		EC157;8108
*EC57		EC157;8108
EC70	468	EC70;6778
EC71	3930	EC71;5718
EC80	1886	EC80;6Q4
EC81	1865;1888	EC81;6R4
EC86		EC86;6CM4
EC88		EC88;6DL4
EC90	133	EC90;6C4;M8080

* Obsolete type with replacement type

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Type to be replaced	CV number	Replacement type
EC91	417	EC91;6AQ4; M8099
EC92		EC92
EC93		EC93
EC97		EC97;6FY5
EC157	5397	EC157;8108
EC158		EC158;8436
EC900		EC900;6HA5
ECC1000		EC1000;8254
EC8010		EC8010
ECC40	3884	ECC40
ECC70	3986	ECC70;6021
ECC81	455	ECC81;12AT7
ECC82	491	ECC82;12AU7
ECC83	492	ECC83;12AX7
ECC84	5281	ECC84;6CW7
ECC85		ECC85;6AQ8
ECC86		ECC86;6GM8
ECC88	5358	ECC88;6DJ8
ECC89		ECC89;6FC7
ECC91	858	ECC91;6J6;M8081
ECC186		ECC186;7316
ECC189	5331	ECC189;6ES8
ECC801		E81CC;6201; 12AT7WA;(M8162)
ECC801S		E81CC;6201; 12AT7WA;(M8162)
ECC802		12AU7WA;6189; (M8136)
ECC802S		12AU7WA;6189; (M8136)
ECC803		12AX7S;7025;M8137
ECC803S		12AX7S;7025; (M8137)
ECC808		ECC808
ECC960		E90CC;5920
ECC962		E92CC
ECC2000		ECC2000
ECF80	5215	ECF80;6BL8; E80CF;7643
ECF86		ECF86;6HG8
ECF200		ECF200;6X9
ECF201		ECF201;6U9
ECF202		ECF202;6AJ9
ECF801		ECF801;6GJ7
ECF802		ECF802;6JW8
ECH21		ECH21
ECH42	3888	ECH42;6CU7
ECH81	2128	ECH81;6AJ8
ECH83		ECH83;6DS8
ECH84		ECH84;6JX8
ECH113		ECH42;6CU7
ECH200		ECH200;6V9
ECL80		ECL80;6AB8
ECL82		ECL82;6BM8
ECL83		ECL83
ECL84		ECL84;6DX8
ECL85		ECL805;6GV8
ECL86		ECL86;6GW8
ECL805		ECL805;6GV8
ED500		ED500;6ED4
EE17		PL5557
EE575A		DCG6/18GB;7136
EE866		866A;DCG4/1000G
EE869B		(6508);(DCG6/20)
EF40	3885	EF40
EF41	3886	EF41;6CJ5
EF42	3887	EF42
EF50		EF50
EF54	380;1136	EF54

Type to be replaced	CV number	Replacement type
EF80	1376	EF80;6BX6
EF83		EF83
EF85	1375	EF85;6BY7
EF86	2901	EF86;6267;M8195
EF89	5156	EF89;6DA6
EF91	138	EF91;6AM6; 6AM6S;M8083
EF92		EF92;6CQ6;M8161
EF93	454	EF93;6BA6
EF94	2524	EF94;6AU6
EF95	850	EF95;6AK5;6AK5W; 5654;E95F;M8100
EF97		EF97;6ES6
EF98		EF98;6ET6
EF183		EF183;6EH7
EF184		EF184;6EJ7
EF730	3928	EF730;5636
EF731	477;475	EF731;5899
EF732	3929	EF732;5840
EF734		EF734;6205
EF861		E180F;6688
EF905		E95F;5664; 6AK5W;M8100
EFL200		EFL200;6Y9
EH90		EH90;6CS6
EH900		(E91H);(6687)
EK90	453	EK90;6BE6
EL34	1741	EL34;6CA7
EL36	2940	EL36;6CM5
EL41	3889	EL41;6CK5
EL42	3890	EL42
EL71		EL71;5902
EL80		EL80:6M5
EL81	2721	EL81;6CJ6
EL82		EL82;6DY5
EL83	2726	EL83;6CK6
EL84	2975	EL84;6BQ5
EL85	3526	EL85:6BN5
EL86	5094	EL86;6CW5
EL90	1862	EL90;6AQ5
EL91	136	EL91;6AM5;M8082
EL95		EL95;6DL5
EL360		EL360
EL500		EL504
EL503		EL503:8278
EL504		EL504;6GB5A
EL505		EL509:6KG6A
EL508		EL508;6KW6
EL509		EL509:6KG6A
EL519		EL519
EL802		EL802;6LD6
EL821	2127	EL821;6CH6
EL822	2382	EL822
EL861		E81L:6686
EL-C3J		PL5632/C3J
EL-C3JA		PL5684/C3JA
EL-C6A		(PL5545A)
EL-C6H-1		(PL5545A)
EL-C6J		(PL5545A)
EL-C6JA		(PL5545A)
EL-C6JK		(PL5545A)
EL-C6L		(PL5545A)
EL-C6M		(PL5545A)
ELL80		ELL80
EM80	1352	EM80:6BR5
EM81	5055	EM81:6DA5
EM84		EM84:6FG6
EM87		EM87:6HU6
EN32	2253	PL6574
EN33		EN33

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Type to be replaced	CV number	Replacement type
EN70	474	EN70
EN91	797	EN91;PL2D21; PL5727;M8204
EN92	3512	5696
EN93	1949	EN93;6D4
ER21A		Z805U;7714
ES85		(TB2.5/300);(5866)
ES204A		TB3/750;5867
ES833		(TB4/1250);(5868)
ES833A		(TB4/1250);(5868)
ESU103		DCX4/1000;3B28
ESU150		(DCG4/5000)
ESU200	5	(DCG4/5000)
ESU575		(DCG6/18GB);(7136)
ESU673		(DCG6/18);(6693)
ESU866	32	DCG4/1000G;866A
ESU866ES		DCG4/1000ED
ESU872	642	DCG5/5000GB;872A
ESU8008		DCG5/5000GS;8008
ET51	5277	ET51;6700
EW3H		(18505);(18506)
EY51	426	EY51;6X2
EY80		EY80;6U3
EY81		EY81;6R3
EY82		EY82;6N3
EY86, EY87	2966	EY802
EY88		EY88;6AL3
EY500, EY500A		EY500A;6EC4A
EZ40	3891	EZ40;6BT4
EZ41		EZ41
EZ80	1535	EZ80;6V4
EZ81	5072	EZ81;6CA4
EZ90	493	EZ90;6X4

Type to be replaced	CV number	Replacement type
F2.5M3		XQ1052;XQ1053
F16-10LD		F16-10LD
F21-10LD		F21-10LD
F31-10LC		F31-10LC
F41-10LC		F41-10LC
F41-11C		F41-11LC
F353		872A;DCG5/5000GB
F353A		872A;DCG5/5000GB
F366A		866A;DCG4/1000G
F369A		(6508);(DCG9/20)
F369B		(6508);(DCG9/20)
F672B		872A;DCG5/5000GB
F869B		(6508);(DCG9/20)
FG17	2957	PL5557
FG27A		(PL5559)
FG57		PL5559
FG97		(PL5557)
FG98A		(PL5557)
FG105		PL105
FG172		(PL105)
FG235A		ZX1052
FG258A		ZX1053
FG271		ZX1051
FS9A		150AVP
FS10A/70		XP1030
FS12-A47		(XP1000)
FS12-A70		(XP1030)
FTL3-2		(TBL7/8000);(6961)
FW4-500	1264	AZ50
FX219	2520	5C22;6279

Type to be replaced	CV number	Replacement type
FX225	1787	6268;4C35A
FX227	372	3C45
FX229	3521	5949
FX231		5C22;6279
G1		3554
G4		(3554);(3546PW)
G5H		(18503)
G9		(3554)
G10/1d		DCG4/1000G;866A
G10/1dv		DCX4/1000;3B28
G10/4d		(DCG5/5000GB)
G20/5d		(DCG9/20);(6508)
G24H		(18545)
G40-25		G40-25
G40-50		G40-50
G48		1163
G49		1163
G108/1K		OB2;OB2WA; M8224
G150/4K		OA2;OA2WA; M8223
G4120		1561
GA50		90AG
GA90		ZM1020
GC10B	2271	Z303C
GD83M		83A1;7980
GD85M/S		85A2;OG3;M8098
GD85WR		(ZZ1000)
GD90M		90C1;M8206
GD100A/S		7475
GD100B		7475
GD100B/S		7475
GD150A/S		150C3;OD3
GD150M		OA3;OA2WA;M8223
GD150M/S		150C2
GL2D21		PL2D21;EN91 PL5727;M8204
GL3C23		PL3C23A
GL57		PL5559
GL238A		ZX1055
GL238B		ZX1055
GL414		PL5559
GL415		(ZX1060)
GL575A		(7136);(DCG6/18GB)
GL673		(6693);(DCG6/18)
GL681		ZX1060
GL807		807;QE6/50
GL813		813;QB2/50
GL829B		(5894);(QQE06/40)
GL832A		832A;QQE04/20
GL866A		866A;DCG4/1000G
GL872A		872A;DCG5/5000GB
GL5544		PL5544
GL5545		PL5545A
GL5550		(ZX1060)
GL5551		ZX1051
GL5551A		ZX1051
GL5552		ZX1052
GL5552A		ZX1052
GL5553A		ZX1053;(ZX1063)
GL5553B		(ZX1053)
GL5555		ZX1055
GL5557		PL5557
GL5559		PL5559

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Type to be replaced	CV number	Replacement type
GL5632		PL5632/3CJ
GL5720		(PL5559)
GL5727		PL5727;M8204
GL5788		(ZX1055)
GL5822		ZX1061
GL5822A		ZX1061
GL5855		(PL255)
GL6011		(PL5684/C3JA)
GL6159		6159;QE05/40H
GL6346		(ZX1051)
GL6347		(ZX1052)
GL6348		(ZX1053)
GL6513		(ZX1055)
GL6514		(ZX1055)
GL6807		PL6807
GL7151		(ZX1063)
GL7681		(ZX1053);(ZX1062)
GLE10000/025/1		DCG4/1000ED
GLE13000/1.5/6		DCG5/5000GB;872A
GLE15000/3/12		DCG6/18;6693
GLE20000/2.5/10		DCG9/20;6508
GN3		ZM1020
GN4		ZM1020
GN6		ZM1080
GR10A		Z503M
GR10M		ZM1022
GR16		ZC1040
GR41		(Z70W)
GR43		(Z70U)
GRG250/3000		PL5557
GS10C	2325	Z502S
GS10C/S		Z502S
GTR83X		(ZZ1000)
GU1		(DCG1/250)
GU12		(DCG4/1000G);(866A)
GU18		(DCG4/5000)
GU20/21		(DCG4/5000)
GU21SP		(DCG4/5000)
GXU1		DCX4/1000;3B28
GXU2		DCX4/5000;4B32
GY86, GY87		GY802
GY501		GY501;3BH2
GZ34	1377	GZ34;5AR4
HC4		(18509)
HF61		EF41
HF62		EF42
HF121		UF41
HF255		(6508);(DCG9/20)
HF258		(DCG4/1000G); (866A)
HL94		HL94;30A5
HMO4		EK90;6BE6
HP6	138	EF91;6AM6
HT17		PL5557
HT415		5C22;6279
J213AAA		1163
JNT1-500	3602	5J26
JP2-0.2		7090
JP2-1A		DX206
JP2-2.5A		YJ1162

Type to be replaced	CV number	Replacement type
JP2-2.5W		YJ1160
*JP2-5W		YJ1191
JP8-02B	6072	JP8-02B
JP9-2.5		7028
JP9-2.5B		YJ1000
JP9-2.5C		JP9-2.5C
JP9-2.5D		JP9-2.5D
JP9-2.4E	10758	JP9-2.5E
JP9-7	3676	2J42
JP9-7A	370	JP9-7A
JP9-7D		JD9-7D
JP9-15	3997	JP9-15;YJ1110
JP9-15B		JP9-15B
JP9-15D	5123	JP9-15D
JP9-18		JP9-18
JP9-50A		JP9-50A
JP9-75		JP9-75
JP9-80	5018	4J52A
JP9-250		4J50
JP35-30		7093
JPS9-200		YJ1180
JPS16-60		YJ1320
JPT9-01	2420	JPT9-01
JPT9-60	3560;5134	2J51A
K50A		K50A
K51A		K51A
K81A		K81A
K211		(YK1110)
K365		(YK1000)
K1209		(54AVP)
K1213		(XP1030)
K1295		(XP1000)
K1299		(XP1001)
K1306		(XP1004)

Type to be replaced	CV number	Replacement type
K1361		150AVP;(XP1180)
K1384		(57AVP)
K1390		XP1030
K1391		(54AVP)
K1430		(150CVP)
K1566		(XP1118)
K1927		XP1002
K1961		XP1001
K2199		XP1001
K2244		(56TVP)
K2253		XP1030
K2276		150CVP
K3017		YK1190
K3018		YK1191
K3003		KS9-40G
K3020		(KS9-40B)
KM2290		XP1005
KM2334		(56AVP/05)
KM2368		(58AVP);(XP1040)
KR11000		YK1091
KS7-85		KS7-85
KS7-85A	5900	KS7-85A
KS9-20	1795	723A/B
KS9-20A	2792	2K25
KS9-20B	9334	KS9-20B
KS9-20D		KS9-20D
KS9-40		KS9-40
KS9-40B		KS9-40B
KS9-40D		KS9-40D
K59-40G		KS9-40G
KS35-50		55335
KS70-40		YK1010
KU676		(PL5632);(C3J)
KXR04-200		YK1090

* Obsolete type with replacement type

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Type to be replaced	CV number	Replacement type
L77	133	EC90;6C4;M8080
LA9-3B	6087	LA9-3B
LB3-250B	6223	LB3-250B
LB4-8		55340
LB6-10		LB6-10
LB6-25		LB6-25
LB6-25A		LB6-25A
LC900		LC900;3HA5
LCF86		LCF86;5HG8
LCF201		LCF201;5U9
LCF801		LCF801;5GJ7
LCF802		LCF802;6LX8
LCL84		LCL84;10DX8
LDR03		LDR03;ORP12
LF183		LF183;4EH7
LF184		LF184;4EJ7
LFL200		LFL200;11Y9
LL86		LL86;10CW5
LL500		LL500;18GB5
LL504		LL504;18GB5A
LL509		LL509;27KG6A
LN119		UCL82
LN152		ECL80;6AB8
LN309		PCL82;16A8
LN329		PCL83
LY88		LY88;20AQ3
LY500 } LY500A }		LY500A;28EC4A
LZ329		PCF80;9A8

Type to be replaced	CV number	Replacement type
M6H		(18524)
M17-140W		M17-140W
M17-141W		M17-141W
M21-11W		M21-11W
M21-12W		M21-12W
M24-100W		M24-100W
M24-101W		M24-101W
M28-12W		M28-12W
M31-120W		M31-120W
M31-130W		M31-130W
M36-11W		M36-11W
*M36-13W		M38-120W
M36-16W		M36-16W
M38-120W		M38-120W
M38-121W		M38-121W
M502	2284	4J50
M503A	1866	JP9-7D
M508	370	JP9-7A
M513		(JP9-15)
M513B		JP9-15
M515		YJ1120
M526	3676	2J42
M541		5J26
M542	3611	5586
M551	5018	4J52A
M559		(YJ040)
M575		JP9-75
M581		YJ1290
M597		YJ1071
M598B		JP9-18
M599A		JP9-2.5D
M599B		JP9-2.5E
M5005		YJ1200
M5022		YJ1121
M5023		YJ1110

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
M5031		JP9-7L
M5042		YJ1250
M5043		YJ1300
M7075		(XQ1042);(XQ1043)
M8079	4025	M8079;5726;E91AA
M8080	4058	M8080
M8081	4031	M8081
M8082	4063	M8082
M8083	4014	M8083
M8098	4048	M8098
M8099	4070	M8099
M8100	4010	M8100;5654; 6AK5W;E95F
M8136	4003	M8136;(6189); 12AU7WA
M8137	4004	M8137;(7025); (12AX7S)
M8161	4015	M8161
M8162	4024	M8162;(12AT7WA); (6201);(E81CC)
M8163	4104;5132	M8163
M8190	4066;3960	M8190;(5783WA)
M8195	4085	M8195
M8196	4011	M8196;(6AS6W); (5725)
M8204	4018	M8204
M8206		M8206
M8212	4007	M8212;(E91AA); (6AL5W);(5726)
M8214	4035	M8214
M8223	4020;4100	M8223;OA2WA
M8224	4028;4101	M8224;OB2WA
M8225	4080	M8225
M8248	5311	M8248
MAG3		2J42
MAG4		YJ1110
MAG16		YJ1121
*MC13-16		Q13-110BA
ME1001	273	EC55;5861
ME1100		723A/B
ME1101		2J42
ME1101A		YJ1110
ME1101D		JP9-7D
ME1401	495;2269	4065
ME1402	2730	4066
ME1403	2348	4068
ME1404		4069
ME1503		(4C35A)
ME1504		PL5559
MG10H		(18520)
MG13-38		MG13-38
MI1050		ZX1051
MI1053		ZX1051
MI1100		ZX1052
MI1103		ZX1052
MI1104		ZX1061
MI1200		ZX1053;ZX1063
MI1203		ZX1053;ZX1063
MI1300		(ZX1063)
MI2053A		ZX1051
MI2100A		ZX1052
MI2103A		ZX1052
MI2104A		ZX1061
MI2200A		ZX1053
MI2203A		ZX1053
*MK13-16		(Q13-110GU)
ML4-125A		4-124A;QB3/300GA
ML4-250A		4-250A;QB3.5/750GA
ML4-400A		4-400A;QB4/1100GA
ML813		813;QB2/250

* Obsolete type with replacement type

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Type to be replaced	CV number	Replacement type
ML833A		(5868);(TB4/1250)
ML866A		866A;DCG4/1000G
ML869B		(6508);(DCG9/20)
ML872A		872;DCG5/5000GB
ML7351A		(XQ1052);(XQ1053)
ML8008		8008;DCG5/500GS
MO10		ET51;6700
MT17		PL5557
MT57	612	PL5559
MT105		PL105
MT5544	2210	PL5544
MT5545	2215	PL5545A
MT5557		PL5557
MT5559		PL5559
MU13-38		MU13-38
*MW13-32		MW13-38
MW13-38		MW13-38
MX113		MX113
MX114		18506
MX118		18537
MX120		18520
MX120/01		18520/01
MX122		18538
MX124		18524;(ZP1082)
MX124/01		18525
MX133		18533;(ZP1083)
MX135		ZP1000
MX136		ZP1010
MX145		18545
MX146		18503
MX147		18504
MX148		18505
MX149		18506
MX151		18509
MX152		18515
MX153		18516
MX157		18515/17
MX158		18516/18
MX163		18529
MX164		18550
MX166		18536
MX167		18546
MX170		18510
MX175		18508
MX177		18552
MX178		18553
MX966B		DCG4/1000G;866A
MY13-38		MY13-38
N1-140/08		ZX1052
N25		DL96;3C4
N77	136	EL91;6AM5;M8082
N119		UL84
N142		UL41;45A5
N144		EL91;6AM5;M8082
N150		EL41;6CK5
N151		EL42
N152		PL81;21A6
N153		PL83;15A6
N154		PL82;16A5
N155		EL85;6BN5
N329		PL82;16A5
N359		PL81;21A6
N379		PL84;15CW5

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
N709		EL84;6BQ5
N727		EL90;6AQ5;M8245
NL575A		DCG6/18GB
NL673		(6693);(DCG6/10)
NL710		(PL5684);PL5559
NL714		(PL3C23)
NL715		PL5557
NL720		PL5684
NL730		(PL6755)
NL778		(PL106)
NL803		(ZM1080)
NL869B		(6508);(DCG9/20)
NL1005		ZX1051
NL1005A		ZX1051
NL1009A		(ZX1062)
NL1009A/P		(ZX1062)
NL1022		ZX1061
NL1022A/P		(ZX1061)
NL1031		ZX1051
NL1032		ZX1053
NL1051A		ZX1051
NL1051A/P		ZX1051
NL1052		ZX1052
NL1052A		ZX1052
NL1052A/P		ZX1052
NL1053		ZX1053
NL1053A		ZX1053
NL0181		ZX1061
NL1081P		ZX1061
NL1082		ZX1062
NL1082P		ZX1062
NL5030		ZM1030
NL5550		(ZX1060)
NL5551		ZX1051
NL5552		ZX1052
NL5553B		ZX1053
NL5553B/P		ZX1053
NL5555		ZX1055
NL5555A		(ZX1055)
NL5684/Ne		(PL5684)
NL6989/C6J/KL		PL5545
NL8421/5092		ZM1020
NL-C6JK/Ne		PL5545
NU807		807;QE06/50
NU813		813;QB2/250
NU832		832A;QQE04/20
NU866A		866A;DCG4/1000G
NU872A		872A;DCG5/5000GB
OA2	1832	OA2;OA2WA;M8223
OA2WA	4020;4100	OA2WA;M8223
OA3		(75C1)
OA4		PL1267/Z300T
OA4G	752	PL1267/Z300T
OB2	1833	OB2;OB2WA;M8224
OB2WA	4028;4101	OB2WA;M8224
OB120-1		OB120-1
OB120-2		OB120-2
OB120-3		OB120-3
OB120-4		OB120-4
OC3		(4687K)
OD3		OD3;150C3
OE3	431	85A1;OE3
OG3	449	85A2;OG3;M8098

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Type to be replaced	CV number	Replacement type
*OH3		90C1
ORP10		ORP10;7632
ORP12		ORP12;LDR03
ORP13		ORP13
*ORP14		RPY14
ORP30N		ORP30N
ORP50		ORP50
ORP52		ORP52
ORP60		ORP60
ORP61		ORP61
ORP62		ORP62
ORP63		ORP63
ORP69		ORP69
*ORP80		RPY13
ORP90		ORP90
ORP93		ORP93
ORP94		ORP94
OT400		(TB4/1250);(5868)
P2-12		QQE04/20;832A
P2-40B		(QQE06/40);(5894)
P6		1163
P15		1164
P810		(XQ1030)
P831		(XQ1040);(XQ1042)
P841		XQ1050;XQ1052
P841X		XQ1051
P842		XQ1040;XQ1042
P842X		XQ1041
P843		XQ1052
P844		XQ1042
P846		(XQ1050);(XQ1052)
P847		(XQ1040);(XQ1042)
P848		XQ1053;XQ1054
P849		XQ1043;XQ1044
P854		55875
P860		XQ1052;XQ1053
P862		XQ1030
P864		(XQ1040 series)
P865		XQ1041;XQ1051
P868		XQ1041
P8000		55875
P8001		55875IG
PA5021		DCG4/1000G;866A
PABC80		PABC80;9AK8
PC86		PC86;4CM4
PC88		PC88;4DL4
PC92		PC92
PC95		PC95;4ER5
PC97		PC97;4FY5
PC900		PC900;4HA5
PCC85		PCC85;9AQ8
PCC88		PCC88;7DJ8
PCC89		PCC89;7EF7
PCC189		PCC189;7ES8
PCF80		PCF80;9A8
PCF86		PCF86;8HG8
PCF200		PCF200;8X9
PCF201		PCF201;8U9
PCF801		PCF801;8GJ7
PCF802		PCF802;9JW8
PCH200		PCH200;9V9
PCL82		PCL82;16A8
PCL83	5144	PCL83-
PCL84		PCL84;15DQ8
PCL85		PCL85;18GV8
PCL86		PCL86;14GW8
PCL805		PCL805
PD500		PD500;9ED4

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
PD510		PD510
PE05/25		PE05/25
PE06/40E		PE06/40E;PE06/40N
PE06/40P		PE06/40P
PE1/100		PE1/100;6083
PF86		PF86
PFL200		PFL200;17Y9
PJ23		(3554)
PL2D21		PL2D21;EN91; PL5727;M8204
*PL3C23		PL3C23A
PL3C23A		PL3C23A
PL10		PL10
PL17		PL5557
PL21		PL2D21;PL5727
PL36		PL36;25E5
*PL57		PL5559
PL81	5077	PL81;21A6
PL82		PL82;16A5
PL83		PL83;15A6
PL84		PL84;15CW5
PL95		PL95
PL105		PL105
PL106		PL106
PL150		PL150
PL255		PL255
PL260		PL260
PL323		PL3C23
PL345	372	3C45
PL435	1787	4C35A;6268
PL435A	5247	4C35A;6268
PL500		PL500;27GB5
PL504		PL504
PL505		PL509;40KG6A
PL508		PL508;17KW6
PL509		PL509;40KG6A
PL519		PL519
PL522	2520	5C22;6279
PL802		PL802;16D6
PL820		PL820
PL1267	1992	Z300T
PL1607		PL1607
PL5544	2210	PL5544
*PL5545	2215	PL5545A
PL5545A		PL5545A
*PL5551		ZX1051
*PL5551A		ZX1051
*PL5552		ZX1052
*PL5552A		ZX1052
*PL5553B		ZX1053
PL5555		ZX1055
PL5557	2957	PL5557
PL5559		PL5559
PL5632		PL5632/C3J
PL5684		PL5684/C3JA
PL5727	4018	PL5727;M8204
*PL5822		ZX1061
PL5822A		ZX1061
PL6011		PL5684/C3JA
PL6549		(QB3/200)
PL6574	2253	PL6574
*PL6755		PL6755A
PL6755A		PL6755A
PL6807		PL6807
PL7981		PL7981
PM04		EF93;6BA6
PM05		EF95;6AK5
PM07		EF91;6AM6
PM61		(XP1113)
PM84		PM84

* Obsolete type with replacement type

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Type to be replaced	CV number	Replacement type
PM101		(XP1110);(XP1111)
PS1010		PS1010
PS1011		PS1011
PS1012		PS1012
PS1013		PS1013
PS1014		PS1014
PS1014SF		PS1014SF
PS1520		PS1520
PS1521		PS1521
PS1531		PS1531
PS2010/50		PS2010/50
PS2010/100		PS2010/100
PS5302		PS5302
PS5400		PS5400
PS5410		PS5410
PTW255		(XQ1030);(XQ1040)
PTW2255		XQ1050
PY80		PY80;19X3
PY81		PY81;17Z3
PY82		PY82;19Y3
PY83		PY83
PY88		PY88;30AE3
PY500 }		PY500A;42EC4A
PY500A }		
PY800		PY800
Q13-110BA		Q13-110BA
Q13-110GU		Q13-110GU
Q160-1		(QB3/300);(6155)
Q400-1		(QB4/1100);(7527)
Q450-1		QB4/1100;7527

Type to be replaced	CV number	Replacement type
QA2400		M8161
QA2401		M8080
QA2402		M8082
QA2403		M8083
QB2/250	26	QB2/250;813
QB3/200	1905	QB3/200;4-65A
QB3/300	2130	QB3/300;6155
QB3/300GA	2963	QB3/300GA;4-125A
QB3.5/750	2131	QB3.5/750;6156
QB3.5/750GA	2964	QB3.5/750GA;4-250A
QB4/1100		QB4/1100;7527
QB4/1100GA		QB4/1100GA;4-400A
QB5/1750	3522	QB5/1750;6079
QB5/2000		QB5/2000;8179
QBL3.5/2000		QBL3.5/2000;8177
QBL4/800		QBL4/800;4X500A
QBL5/3500		QBL5/3500;6076
QBL5/4000		QBL5/4000;7704
QBW5/3500		QBW5/3500;6075
QC05/35		QC05/35;8042
QE03/10		QE03/10;5763;M8096
QE05/40	3523	QE05/40;6146
QE05/40F		QE05/40F;6883
QE05/40H		QE05/40H;6159
QE05/40K		QE05/40K;8032
QE08/200		QE08/200;7378
QE08/200H		QE08/200H;7836
QEL1/150	2519	QEL1/150;4X150A
QEL1/150H		QEL1/150H;4X150D
QEL2/200		QEL2/200;7580
QEL2/275		QEL2/275;4CX250B
QEL2/275H		QEL2/275H; 4CX250F
QQC03/14		QQC03/14;7983

Type to be replaced	CV number	Replacement type
QQC04/15	1838	QQC04/15;5895
QQE02/5	2466	QQE02/5;6939
QQE03/12	2798	QQE03/12;6360
QQE03/20	2799	QQE03/20;6252
QQE04/5		QQE04/5;7377
QQE04/20	788	QQE04/20;832A
QQE06/40	2797	QQE06/40;5894
QQV02-6		QQE02/5;6939
QQV03-10	2798	QQE03/12;6360
QQV03/20A	2799	QQE03/20;6252
QQV04-15	788	QQE04/20;832A
QQV04-16		QQE04/5;7377
QQV06-40A	2797	(QQE06/40);(5894)
QQV07-40	2666	QQV07/40;829B
QQV5-P10	2295;?599	QQV5-P10;3E29
QQZ03-10		QQC03/14;7983
QQZ03-20		YL1020;8118
QQZ04-15	1838	QQC04/15;5895
QQZ06-40		YL1030
QS75-20		75B1
QS83-3		(85A2);(OG3);M8098
QS92-10		7475
QS95-10		95A1
QS150-40		150C3;OD3
QS1200	2225	150B2;6354;M8163
QS1207	1832	OA2;OA2WA;M8223
QS1208	1833	OB2;OB2WA;M8224
QS1209		85A2
QS1210		OA2WA;M8223
QS1211		OB2WA;M8224
QS1212		M8098
QS1213		M8142
QS1215		90C1
QS1250		(5823);(Z900T)
QS2404		M8079
QS2406		M8162;6201; E81CC;12AT7WA
QV03-12	2129	QE03/10;5763
QV04-7	309;1510	QE04/10
QV05-10	3990	QV05-10;2E26
QV06-20	3523	QE05/40;6146
QV06-20B		QE05/40F;6883
QV06-20C		QE05/40H;6159
QV08-100		QE08/200
QV08-100B		YL1290
QV1-150A	2519	QEL1/150
QV1-150D		QEL1/150H;4X150D
QV2-250C		QEL2/275;4CX250B
QY2-100	26	QB2/250;813
QY3-65	1905	QB3/200;4-65A
QY3-125	2130	QB3/300;6155
QY3-125B	2963	QB3/300GA;4-125A
QY3-1000A		QBL3.5/2000;8177
QY4-250	2131	QB3.5/750;6156
QY4-250B	2964	QB3.5/750GA;4-250A
QY4-400		QB4/1100;7527
QY4-400B		QB4/1100GA;4-400A
QY4-500A		QBL4/800;4X500A
QY5-500	3522	QB5/1750;6079
QY5-800		QB5/2000;8179
QY5-3000A		QBL5/3500;6076
QY5-3000W		QBW5/3500;6075
QZ06-20		QC05/35;8042

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Type to be replaced	CV number	Replacement type
R6A		1163
R12	426	EY51;6X2
R12A		EY51;6X2
R15A		1164
R120		(1725A)
R142		R142
R243	273	EC55;5861
R290		K81A
RG1-125		(DCG4/1000G);(866A)
RG1-240A		RG1-240A
RG1-250	3667	DCG1/250
RG3-250	1625	DCG4/1000ED
RG3-250A	32	DCG4/1000G;866A
RG3-1250		DCG4/5000
RG4-1250	5	RG4-1250
RG4-3000		DCG6/18;6693
RG250/1000		DCG1/250
RG250-3000		DCG4/1000G;866A
RG1000/3000		DCG5/5000GB;872A
RHK6332		723A/B
RI-12		RI-12
RI-20		RI-20
RK807		QE6/50;807
RK866		DCG4/1000G;866A
RL17		PL5557
RL21		PL2D21;EN91; PL5727
RL57		PL5559
RL105		PL105
RL1267		PL1267/Z300T
RL16989/Ne		(PL5545)
RPY13		RPY13
RPY14		RPY14
RPY18		RPY18
RPY19		RPY19
RPY20		RPY20
RPY27		RPY27
RPY33		RPY33
RPY37		RPY37
RPY40		RPY40
RPY41		RPY41
RPY43		RPY43
RPY54		RPY54
RPY55		RPY55
RPY58		RPY58
RPY71		RPY71
RPY76A		RPY76A
RR3-250	1835	DCX4/1000;3B28
RR3-1250		DCX4/5000;4B32
RR3-1250A	2399	RR3-1250A
RR3-1250B		DCX4/5000;4B32
RS612		(TB2.5/400)
RS613		TBL2.5/300;5866
RS614		TB2.5/400
RS630		TB3/750;5867
RS631		TB4/1250;5868
RS685		QB3/300;6155
RS686		QB3.5/750;6156
RS687		QB5/1750;6079
RS1002A		QB4/1100;7527
RS1003		(YL1200)
RS1006B		TB2.5/400
RS1007		QB3/300;6155
RS1009		QQE06/40;5894
RS1011L		(TBL6/20)
RS1011W		(TBW6/20)
RS1012L		YL1181
RS1012V		YL1182
RS1016		TB4/1250;5868

Type to be replaced	CV number	Replacement type
RS1019		QQE03/20;6252
RS1026		TB3/750;5867
RS1029		QQE03/12;6360
RS1036		TB4/1500
RS1041V		YD1012
RS1041W		YD1010
RS1046		TB5/2500;7092
RS1082CL		YL1011
RS1082CV		YL1012
RS1082CW		YL1010
RS2002V		YL1091
RS2002W		YL1090
RS2021L		YD1001
RS2021V		YD1002
RS2021W		YD1000
RT47H4		A47-11W
RT47T1		(19CWP4)
RT59-H4		A59-11W
RT59T1		A59-16W
RX120A		1164
RY12-100	2967	8020
S1.5/80dv		PL5545
S15/5d		(DCG12/30);(5870)
S15/40		(DCG7/100)
S15/40i		(DCG7/100)
S856		OA2;OA2WA;M8223
S860		OB2;OB2WA;M8224
S5600		S5600
S5600/01		S5600/01
S5600/02		S5600/02
S5600/03		S5600/03

Type to be replaced	CV number	Replacement type
SAS		(ZX1060)
SBS		ZX1051
SCS		ZX1052
SCS3		ZX1061
SDR		ZX1055
SDS		ZX1053;(ZX1063)
SL109		SL109
SP6		EF91;7AM6
SR6		ZZ1000
SR44		ZZ1000
SR55		OB2
SR56		OA2
SRS360		TB3/750;5867
SRS361		TB2.5/300;5866
SRS362		TB4/1250;5868
SRS455		QB3/300;6155
SRS456		QB3.5/750;6156
SRS457		QB5/1750;6079
SRS4451		QQE06/40;5894
SRS4452		QQE3/20;6252
ST11		7475
Ste1000/2.5/15		PL5559
Ste1300/01/05		PL2D21;PL5727; EN91
Ste1500/15/45		(DCG7/100)
Ste2500/6/40		PL105
STV85/10		85A2;OG3
STV108/30		OB2;PB2WA;M8224
STV150/30		OA2·OA2WA;M8223
SU61		EY51;6X2

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Type to be replaced	CV number	Replacement type
T2M05		ECC91;6J6;M8081
T130-1		(TB2.5/400)
T300-1		(TB4/1250);(5868)
T350-1		(TB3/750);(5867)
T380-1		TB3/750;5867
T500-1		TB4/1250;5868
T813		813;QB2/250
T866A		866A;DCG4/1000G
T872A		872A;DCG5/5000GB
*TA12/20000K		TAW12/20
TAL12/10		TAL12/10
TAL12/20		TAL12/20
TAL12/35		TAL12/35
TAW12/10		TAW12/10
TAW12/20		TAW12/20
TAW12-35G		TAW12-35G
TB2.5/300	1924	TB2.5/300;5866
TB2.5/400		TB2.5/400;7986
TB3/750	1350	TB3/750;5867
TB4/1250	1351	TB4/1250;5868
TB4/1500		TB4/1500;8078
TB5/2500		TB5/2500·7092
TBH6/14		TBH6/14;8591
TBH6/6000		TBH6/6000;8610
TBH7/8000		TBH7/8000;8592
TBH7/9000		TBH7/9000;8592
TBH12/25		TBH12/25
TBH12/38		TBH12/38;8594
TBL2/300		TBL2/300;7004
TBL2/400		TBL2/400;8119
TBL2/500		TBL2/500;8120
TBL6/14		TBL6/14;7804
TBL6/20		TBL6/20
TBL6/4000		TBL6/4000;7753
TBL6/6000;3926		TBL6/6000;5924
TBL7/8000		TBL7/8000;6961
TBL7/9000		TBL7/9000;8269
TBL12/25		TBL12/25;6618
TBL12/38		TBL12/38;7806
TBL12/40		TBL12/40;7800
TBL12/100		TBL12/100;6078
TBL15/125		TBL15/125
TBW6/14		TBW6/14;7805
TBW6/6000		TBW6/6000;5923
TBW7/8000		TBW7/8000;6960
TBW7/9000		TBW7/9000;8268
TBW12/25		TBW12/25;6617
TBW12/38		TBW12/38;7807
TBW12/100		TBW12/100;6077
TBW15/125		TBW15/125
*TC2/250		TB3/750;5867
*TC2/3000		TB3/750;5867
TD03-10	273	TD03-10
TD03-10G		EC55;5861
TD2-300A		TBL2/300;7004
TD2-400A		TBL2400;8119
TD2-500A		
TFZ103B		(PL5544
TFZ106B		(PL5545)
TG30		3C45
TG57		PL5559
TG200B		4C35A
TG1000		5C22
TG3000		5949
TH71		TH71
TH73		TH73
TH75		TH75
TH302		(YD1300)
TH308		(YD1330)
TH328		(YD1330)

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
TH813	26	813;QB2/250
TH1450		4J50
TH1526		5J26
TH1586		5586
TH1725A		725A
TH2225		2K25
TH5021B		866A;DCG4/1000G
TH5021V		DCG4/1000ED
TH5031B		872A;DCG5/5000GB
TH5031V		DCG5/5000EG
TH5040		(6508);(DCG9/20)
TH5090		(7136);(DCG6/18GB)
TH5130		(6693);(DCG6/18)
TH5521V/B		3B28;DCX4/1000
TH6011		PL5557
TH6031		PL5559
TH6050		(PL5559)
TH6120		PL105
TH6220		PL5545A
TH6220A		PL5545A
TH6230		PL3C23
TH6345		3C45
TH6435		4C35A
TH6522		5C22
TH6907		5949
TH7010		(ZX1060)
TH7020		ZX1051
TH7021		(ZX1051)
TH7023		ZX1051
TH7030		ZX1052;(ZX1063)
TH7031		(ZX1052);(ZX1063)
TH7033		ZX1052;(ZX1063)
TH7034		ZX1061
TH7035		(ZX1062)
TH7036		ZX1062
TH7040		ZX1053
TH7041		(ZX1053)
TH7043		ZX1053
TH9800		XQ1040
TH9801		(XQ1040)
TH9804		(XQ1040)
TH9805		(XQ1043)
TH9806		XQ1053
TH9807		XQ1050;XQ1052
TH9808		(XQ1043)
TH9809		(XQ1042)
TH9810		(XQ1040)
TH9811		(XQ1040)
TH9812		(XQ1051)
TH9815		XQ1051
TH9821		XQ1010
TH9824		XQ1010
THX806		(XQ1010)
TQ1/2		PL3C23A
TQ2		(PL5557)
TQ2/3		(PL6755A)
TQ2/6		(PL106)
TQ2/12		(PL255)
TQ6		(5870);(DCG12/30)
TQ7		(DCG7/100)
TS49		C3m
TS51/EF95		EF95;6AK5
TS52/ECC91		ECC91;6J6;M8081
TS53/18042		1842;6086
TS54/E83F		E83F;6689
TS56/18014		18014
TT10		QB2/250
TT15		(QQE04/20)·(832A)
TT16		QB3/300GA;4-125A

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Type to be replaced	CV number	Replacement type
TT16D		QB3/300;6155
TT17		PL5557
TT20		QQE03/20;6252
TVHC40		TVHC40
TX2/3		PL5544
TX2/6		PL5544A
TX2/61		PL6807
TX12-20A		(TAL12/20)
TX12-20W		(TAW12/20)
TX920		PL5559
TXM100		PL2D21;EN91; PL5727
TY2-125	1924	TB2.5/300;5866
TY2-150		TB2.5/400
TY3-250	1350	TB3/750;5867
TY4-350		(TB4/1250);(5868)
TY4-400		TB3/750;5867
TY4-400C		YD1220;TY4-400C
TY4-500	1351	TB4/1250;5868
TY5-500		TB4/1500
TY6-12A		TBL6/20
TY6-12W		TBW6/20
TY6-800		TB5/2500;7092
TY6-1250A		TBL6/4000;7753
TY6-3000A		YD1230
TY6-5000A		TBL6/6000;5924
TY6-5000B		YD1120
TY6-5000H		TBH6/6000
TY6-5000W		TBW6/6000;5923
TY7-6000A		TBL7/8000;6961
TY7-6000H		TBH7/8000
TY7-6000W		TBW7/8000;6960
TY8-15A		TBL6/14;7804
TY8-15H		TBH6/14;8591
TY8-15W		TBW6/14;7805
TY8-6000A		TBL7/9000;8269
TY8-6000W		TBW7/9000;8268
TY8-6000H		TBH7/9000;8593
TY12-15A		TBL12/40
TY12-30A		TBL12/38;7806
TY12-20H		TBH12/38;8594
TY12-20W		TBW12/38;7807
TY12-25A		TBL12/25;6618
TY12-25W		TBW12/25;6617
TY12-50A		TBL12/100;6078
TY12-50W		TBW12/100;6077
TY12-120W		YD1010
TY74		(PL5557)
TY76		(PL5559)
TY77		(PL5559)
TY78		(PL5559)
TY84		(PL5559)
TY85		(PL105)
TY6030		(PL5559)
TY6050		(PL5559)
TY6100		(PL5559)
TY6120		(PL105)
TY6220		(PL5545)
U-25/08		(ZX1060)
U-25/08P		(ZX1060)
U49		EY802
U-70/08		ZX1051
U-70/08P		ZX1051

Type to be replaced	CV number	Replacement type
U78	493	EZ90;6X4
U119		UY85;38A3
U-140/08		ZX1052
U-140/08P		ZX1052
U142		UY41;31A3
U150		EZ40;6BT4
U152		PY80;19X3
U153		PY81;17Z3
U154		PY82;19Y3
U192		PY82;19Y3
U-350/08		ZX1053
U-350/08P		ZX1053
U381		UY85;38A3
U709		EZ81;6CA4
UABC80		UABC80
UAF42		UAF42;12S7
UBC41		UBC41;14L7
UBC81		UBC81
UBF80		UBF80;17C8
UBF89		UBF89;19FL8
UCC85		UCC85
UCH42		UCH42;14K7
UCH80		UCH80-14Y7
UCH81		UCH81;19D8
UCL82		UCL82;50BM8
UE966A		866A;DCG4/1000G
UE967		PL5557
UE972A		872A;DCG5/5000GB
UF41		UF41;12AC5
UF42		UF42
UF80		UF80
UF85		UF85
UF89		UF89
UL41	1977	UL41;45A5
UL84		UL84;45B5
UM84		UM84
UU12		EZ81;6CA4
UX866		866A;DCG4/1000G
UY41		UY41;31A3
UY42		UY42
UY82		UY82;55N3
UY85		UY85;38A3
UY89		UY89;31AV3
UY807		807;QE06/50
V2M70		EZ90;6X4
V40		8020
V41		AZ41
V54		YK1090
V61		EZ40;6BT4
V154		YK1091
V1103		6360;QQE03/12
VH550		DCG4/1000ED
VH550H		DCG4/1000G;866A
VH7400		DCG5/5000GB;872A
VH7400A		DCG5/5000EG
VJ5551		ZX1051
VJ5551A		ZX1051
VJ5552A		ZX1052
VJ5553		ZX1053
VJ5553B		ZX1053
VMP11/30		(150AVP
VMP11/44		(56AVP)
VMP11/44A		(XP1001)
VMP11/44B		(XP1000)

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Type to be replaced	CV number	Replacement type
VMP11/44C		(XP1000)
VMP11/111		(54AVP)
VMP11/170		(57AVP
VMP13/44		(56AVP/05)
BMQ11/44		(XP1004)
VMQ13/44		(56UVP)
VR105-30		OB2;OB2WA;M8224
VR150-30	216	150C3;OD3
VS70		7475
[1])VT39		(6508);(DCG9/20)
VT39A		(6508);(DCG9/20)
VT42A		(872A); (DCG5/5000GB)
VT46		(866A); (DCG4/1000G)
VT46A		866A;DCG4/1000G
VT88		(832A);(QQE04/20)
VT88A		832A;QQE04/20
VT100		807;QE06/50
VT118		832A;QQE04/20
VT144		QB2/250
VT259		(5894);(QQE06/40)
VT267	2967	8020
VT286		832A;QQE04/20
VT510		QE04/10
VTP7386		(PL5545)
VU134		1877
VX32B		(4065)
VX41		(4066)
[2])VX550A		DCX4/1000;3B28
[2])VX7400		DCX4/5000;4B32

Type to be replaced	CV number	Replacement type
W17	781	DF91;1T4
W25		DF96;1AJ4
W77	131	EF92;6CQ6;M8161
W142		UF41;12AC5
W150		EF41;6CJ5
W719		EF85;6BY7
W727		6BA6;EF93
WD119		UBF89;19FL8
WD142		UAF42;12S7
WD150		EAF42;6CT7
WD709		EBF80;6N8
WE17		PL5557
WE289A		1163
WL2D21		PL2D21;EN91; PL5727;M8204
WL17		PL5557
WL57		PL5559
WL105		PL105
WL172		(PL105)
WL414		(PL255)
WL502A		(PL5727);(M8204)
WL575A		DCG6/18GB);(7136)
WL624		(PL105)
WL631		PL5559
WL632A		(PL5559)
WL676		(PL105)
WL813		813;QB2/250
WL866A		866A;DCG4/1000G
WL869B		(6508);(DCG9/20)
WL872A		872A;DCG5/5000GB
WL885		PL2D21);(EN91); (PL5727);(M8204)
WL5550		(ZX1060)
WL5551		ZX1051
WL5551A		ZX1051

[1]) American VT-numbers unless otherwise stated.
[2])SFR

Type to be replaced	CV number	Replacement type
WL5552		ZX1052
WL5552A		(ZX1052)
WL5553		ZX1053;(ZX1063)
WL5553A		ZX1053
WL5553B		ZX1053;(ZX1063)
WL5555		ZX1055
WL5555A		(ZX1055)
WL5557		PL5557
WL5559		PL5559
WL5685		(PL5545A)
WL5720		(PL5559)
WL5822		ZX1061
WL5822A		(ZX1061)
WL6376		(ZP1010)
WL6998		(ZP1000)
WL7306		PL5684
WL289-416D		1163
WT210-0001		PL2D21;EN91; PL5727;M8204
WT210-0015		PL5557
WT210-0018		(150C1K)
WT210-0056		PL5559
WT210-0062		PL5557
WT210-0069		PL5557
WT210-0071		ZX1051
WT210-0072		(ZX1052)
WT210-0073		(ZX1053)
WT210-0074		PL105
WT210-0079		PL105
WT210-0091		(PL1267/Z300T)
WT272		PL5557
WTT108		PL3C23
WTT11		PL5559
WTT117		PL5557
WTT118		PL105
X119		UCH81;19D8
X142		UCH42;14K7
X150		ECH42;6CU7
X719		ECH81;6CJ8
XA1000		XA1000
XA1001		XA1001
XA1002		XA1002
XA1003		XA1003
XAA91		XAA91;3AL5
XB767A		(PL2D21);(EN91); (PL5727);(M8204)
XC31		(Z70U)
XC900		XC900;2HA5
XCC189		XCC189;4ES8
XCF80		XCF80;4BL8
XCF801		XCF801;4GJ7
XCF802		XCF802;4JW8
XCH81		XCH81;3AJ8
XCL82		XCL82;8B8
XCL85		XCL85;9GV8
XF86		XF86;2HR8
XF183		XF183;3EH7
XF184		XF184;3EJ7
XG1-2500		PL5559
XG2		EN70
XG2-12		PL255
XG2-25		PL260
XG2-500	1144	(PL5557)
XG2-6400		(PL105)
XG5-500	2957	PL5557

Type to be replaced	CV number	Replacement type
XG15-10		6786;DCG7/100B
XG15-12		(DCG7/100B)
XGQ2-6400		PL105
XH3-045	372	3C45
XH8-100	1787	4C35A
XH16-200	2520	5C22
XH25-500	3521	5949
XL36		XL36;13CM5
XL500		XL500;13GB5
XL7900/00		XL7900/00
XN3		ZM1080
XP1000		XP1000
XP1001		XP1001
XP1002		XP1002
XP1003		XP1003
XP1004		XP1004
XP1005		XP1005
XP1006		XP1006
XP1010		XP1010
XP1011		XP1011
XP1015		XP1015
XP1016		XP1016
XP1020		XP1020
XP1021		XP1021
XP1023		XP1023
XP1030		XP1030
XP1031		XP1031
XP1032		XP1032
XP1033		XP1033
XP1034		XP1034
XP1040		XP1040
XP1041		XP1041
XP1050		XP1050
XP1051		XP1051
XP1052		XP1052
XP1053		XP1053
XP1060		150AVP
XP1070		XP1030
XP1090		XP1000
XP1110		XP1110
XP1113		XP1113
XP1114		XP1114
XP1115		XP1115
XP1116		XP1116
XP1117		XP1117
XP1118		XP1118
XP1119		XP1119
XP1120		XP1120
XP1121		XP1121
XP1122		XP1122
XP1123		XP1123
XP2230		XP1130
XP1131		XP1131
XP1140		XP1140
XP1141		XP1141
XP1143		XP1143
XP1180		XP1180
XP1190		XP1190
XP1191		XP1191
XP1193		XP1193
XP1200		XP1200
XP1210		XP1210
XP1220		XP1220
XP1230		XP1230
XP2000		XP2000
XP2020		XP2020
XP2030		XP2030
XQ1001		XQ1051
XQ1002		XQ1050
XQ1003		XQ1052;XQ1053

Type to be replaced	CV number	Replacement type
XQ1004		XQ1054
XQ1010		XQ1010
XQ1020		XQ1020
XQ1020B		XQ1020B
XQ1020G		XQ1020G
XQ1020L		XQ1020L
XQ1020R		XQ1020R
XQ1021		XQ1021
XQ1021B		XQ1021B
XQ1021G		XQ1021G
XQ1021R		XQ1021R
XQ1022		XQ1022
XQ1023		XQ1023
XQ1023L		XQ1023L
XQ1023R		XQ1023R
XQ1024		XQ1024
XQ1024R		XQ1024R
XQ1025		XQ1025
XQ1025L		XQ1025L
XQ1025R		XQ1025R
XQ1026		XQ1026
XQ1026R		XQ1026R
XQ1031		XQ1031
XQ1032		XQ1032
XQ1060		XQ1060
XQ1061		XQ1061
XQ1062		XQ1062
XQ1063		XQ1063
XQ1064		XQ1064
XQ1065		XQ1065
XQ1070		XQ1070
XQ1070/01		XQ1070/01
XQ1070B		XQ1070B
XQ1070/01B		XQ1070/01B
XQ1070G		XQ1070G
XQ1070/01G		XQ1070/01G
XQ1070L		XQ1070L
XQ1070/01L		XQ1070/01L
XQ1070R		XQ1070R
XQ1070/01R		XQ1070/01R
XQ1071		XQ1071
XQ1071/01		XQ1071/01
XQ1071B		XQ1071B
XQ1071/01B		XQ1071/01B
XQ1071G		XQ1071G
XQ1071/01G		XQ1071/01G
XQ1071R		XQ1071R
XQ1071/01R		XQ1071/01R
XQ1072		XQ1072
XQ1073		XQ1073
XQ1073R		XQ1073R
XQ1074		XQ1074
XQ1074R		XQ1074R
XQ1075		XQ1075
XQ1075R		XQ1075R
XQ1076		XQ1076
XQ1076R		XQ1076R
XQ1080 series		XQ1080 series
XQ1081 series		XQ1081 series
XQ1090		XQ1090
XQ1091		XQ1091
XQ1100		XQ1100
XQ1101		XQ1101
XQ1102		XQ1102
XQ1220 series		XQ1220 series
XQ1230 series		XQ1230 series
XQ1240		XQ1240
XQ1241		XQ1241
XQ1270		XQ1270
XQ1271		XQ1271

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Type to be replaced	CV number	Replacement type
XQ1272		XQ1272
XR1-12		XR1-12;5855
*XR1-1600		PL5684/C3JA
XR1-1600A	5234	PL5684/C3JA
XR1-3200	2210	PL5544
XR1-3200A		PL7981
XR1-6400	2215	PL5545A
XR1-6400A		PL6807;(PL5545A)
XR81		55335
XY88		XY88;16AQ3
YD1000		YD1000
YD1001		YD1001
YD1002		YD1002
YD1010		YD1010
YD1012		YD1012
YD1050		YD1050
YD1051		YD1051
YD1120		YD1120
YD1130		YD1130;8163
YD1140		YD1140
YD1141		YD1141
YD1150		YD1150;8728
YD1151		YD1151;8729
YD1152		YD1152;8730
YD1160		YD1160;8731
YD1161		YD1161;8732
YD1162		YD1162;8733
YD1170		YD1170;8666
YD1171		YD1171;8667
YD1172		YD1172;8668
YD1173		YD1173;8734
YD1175		YD1175
YD1177		YD1177
YD1180		YD1180;8801
YD1182		YD1182;8735
YD1185		YD1185;8935
YD1187		YD1187;8936
YD1192		YD1192;8736
YD1193		YD1193
YD1195		YD1195;8913
YD1197		YD1197;8937
YD1202		YD1202;8752
YD1203		YD1203
YD1204		YD1204
YD1212		YD1212;8680
YD1213		YD1213
YD1230		YD1230
YD1240		YD1240
YD1300		YD1300
YD1330		YD1330
YD1342		YD1342;8918
YD1343		YD1343
YD1352S		YD1352S;8867
YH1090		YH1090
YH1170		YH1170
YH1172		YH1172
YH1210		TH1210
YJ1000		YJ1000
YJ1010		YJ1010
YJ1011		YJ1011
YJ1020		YJ1020
YJ1021		YJ1021
YJ1030	6225	YJ1030
YJ1040		YJ1040
YJ1060		YJ1060
YJ1071		YJ1071
*YJ1080		YJ1160
*YJ1082		YJ1162
YJ1100	6215	YJ1100
YJ1110		YJ1110

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
YJ1112		YJ1112
YJ1120		YJ1120
YJ1121		YJ1121
YJ1140		YJ1140
YJ1150		YJ1150
YJ1160		YJ1160
YJ1162		YJ1162
YJ1180		YJ1180
YJ1181		YJ1181
YJ1182		YJ1182
*YJ1190		YJ1191
YJ1191		YJ1191
YJ1200		YJ1200
YJ1250		YJ1250
YJ1280		YJ1280
YJ1290		YJ1290
YJ1300		YJ1300
YJ1320		YJ1320
YJ1321		YJ1321
YJ1390		YJ1390
YJ1420		YJ1420
YJ1421		YJ1421
YJ1440		YJ1440
YK1000		YK1000
YK1001		YK1001
YK1002		YK1002
YK1004		YK1004
YK1005		YK1005
YK1010		YK1010
YK1061		YK1061
YK1090		YK1090
YK1091		YK1091
YK1110		YK1110
YK1151		YK1151
YK1190		YK1190
YK1191		YK1191
YL1000		YL1000:8463
YL1010		YL1010
YL1011		YL1011
YL1012		YL1012
YL1020		YL1020:8118
YL1030		YL1030
YL1060		YL1060:7854
YL1070		YL1070:8117
YL1071		YL1071:8116
YL1080		YL1080:8348
YL1090		YL1090
YL1091		YL1091
YL1100		YL1100:6884
YL1101		YL1101:6816
YL1102		YL1102:7843
YL1103		YL1103:7844
YL1110		YL1110:7650
YL1120		YL1120:8429
YL1121		YL1121
YL1130		YL1130:8408
YL1150		YL1150:8579
YL1170		YL1170:7580W
YL1181		YL1181
YL1182		YL1182
YL1190		YL1190:8580
YL1200		YL1200
YL1210		YL1210:8457
YL1220		YL1220:8577
YL1230		YL1230:8654
YL1240		YL1240:8458
YL1250		YL1250:8505
YL1290		YL1290
YL1300		YL1300:8637

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
YL1320		YL1320;8560
YL1321		YL1321
YL1322		YL1322
YL1330		YL1330;8744
YL1340		YL1340;8321
YL1341		YL1341;8322
YL1360		YL1360;8683
YL1370		YL1370;6146B;8298A
YL1371		YL1371;6883B
YL1372		YL1372;6159B
YL1420		YL1420;8812
YL1430		YL1430;8813
YL1440		YL1440;8814
YL1460		YL1460
YL1461		YL1461
YL1470		YL1470;8888
YL1520		YL1520;8915
YX1172		YX1172
YX1220		YX1220
*Z50T		Z71U;7711
Z70U		Z70U;7710
*Z70W		7709
*Z71U		7711
Z77	138	EF91;6AM6;M8083
Z90		EF50
Z142		UF42
Z150		EF42
Z152		EF80;6BX6
Z225		(DCG4/1000G)
Z300T	1992	PL1267/Z300T
Z302C		Z302C
Z303C	2271	Z303C
Z500T		Z500T
Z502S	2325	Z502S

Type to be replaced	CV number	Replacement type
Z504S		Z504S;ZM1070
Z505S		Z505S;ZM1060
*Z510M		ZM1020
*Z520M		ZM1020
*Z521M		ZM1021
*Z522M		ZM1040
*Z550M		ZM1050
Z700U		Z70U;7710
Z700W		7709
Z701U		7711
Z719		EF80;6BX6
Z729	2901	EF86;6267;M8195
Z800U		Z800U;6538
Z801U		Z801U;6539
Z803U	2434	Z803U;6779
*Z805U		7714
Z806W		Z806W
Z860X		(Z803U)
Z861X		(Z805U);(7714)
Z900T	5122	Z900T;5823
Z901T		Z801T
Z5823		Z900T;5823
Z7869		(XQ1070);(XQ1071)
Z7870		XQ1070;XQ1071
Z7999		5875
*ZA1000		ZA1002
ZA1001		ZA1001
ZA1002		ZA1002
*ZA1003		ZA1004
ZA1004		ZA1004
ZA1006		ZA1006
ZC1010		(Z70W)
ZC1040		ZC1040
ZC1050		ZC1050
ZD152		EBF80;6N8

* Obsolete type with replacement type

Type to be replaced	CV number	Replacement type
ZM1000		ZM1000
ZM1000R		ZM1000R
ZM1001		ZM1001
ZM1001R		ZM1001R
ZM1002		ZM1002
ZM1005		ZM1005
ZM1005R		ZM1005R
ZM1020		ZM1020
ZM1020/01		ZM1020/01
ZM1021		ZM1021
ZM1022		ZM1022
ZM1023		ZM1023
ZM1024		ZM1024
ZM1025		ZM1025
ZM1030		ZM1030
ZM1031/01		ZM1031/01
ZM1032		ZM1032
ZM1033/01		ZM1033/01
ZM1040		ZM1040
ZM1041		ZM1041
ZM1042		ZM1042
ZM1043		ZM1043
ZM1050		ZM1050;8453;Z550M
ZM1060		ZM1060;Z505S
ZM1070		ZM1070;Z504S
ZM1080		ZM1080
ZM1081		ZM1081
ZM1082		ZM1082
ZM1083		ZM1083
ZM1160		ZM1160
ZM1162		ZM1162
ZM1170		ZM1170
ZM1172		ZM1172
ZM1174		ZM1174
ZM1175		ZM1175
ZM1176		ZM1176
ZM1177		ZM1177
ZM1200		ZM1200
ZM1202		ZM1202
ZM1204		ZM1204
ZM1206		ZM1206
ZM1230		ZM1230
ZM1232		ZM1232
ZM1310		ZM1310
ZM1320		ZM1320
ZM1325		ZM1325
ZP1080		ZP1080
ZP1083		ZP1083
ZP1100		ZP1100
ZT1000		ZT1000;8270
ZT1001		ZT1001;8482
ZT1011		PL5684/C3JA
*ZX1000		ZX1060
ZX1040		(ZX1062)
ZX1051		ZX1051
ZX1052		ZX1052
ZX1053		ZX1053
ZX1055		ZX1055
ZX1060		ZX1060
ZX1061		ZX1061
ZX1062		ZX1062
ZX1063		ZX1063
ZX1081		ZX1081
ZX1082		ZX1082
ZY1000		ZY1000;872A
ZY1001		ZY1001;8008A
ZY1002		ZY1002
ZZ1000		ZZ1000:8228
ZZ1010		(90C1)
ZZ1020		(ZZ1000)

* Obsolete type with replacement type

CV number	Comparable type
CV5	RG4-1250
CV26	QB2/250;813
CV32	DCG4/1000G;866A
CV131	6CQ6;EF92
CV133	6C4;EC90
CV136	EL91;6AM5
CV138	6AM6;EF91
CV152	DCG4/5000
CV273	CV273
CV283	6AL5;EAA91
CV284	75B1
CV286	95A1
CV370	JP9-7A
CV372	3C45
CV380	EF54
CV417	6AQ4;EC91
CV424	QQE06/40;5894
CV426	EY51;6X2
CV431	85A1;OE3
CV449	85A2;OG3
CV452	6AT6;EBC90
CV454	EF93;6BA6
CV455	ECC81;12AT7
CV468	EC70;6778
CV469	6489;EA76
CV474	EN70
CV475	EF731;5899
CV477	EF731;5899
CV491	ECC82;12AU7
CV492	ECC83;12AX7
CV493	EZ90;6X4
CV495	4065
CV635	(TB4/1250P);5868)
CV642	DCG5/5000GB;872A
CV722	725A
CV753	1A3/DA90
CV788	QQE04/20;832A
CV797	PL2D21;EN91; PL5727;M8204
CV850	EF95;6AK5
CV858	6J6;ECC91
CV1070	7475
CV1136	EF54
CV1350	TB/750;5867
CV1351	TB4/1250;5868
CV1352	6BR5;EM80
CV1355	RG4-1250
CV1375	6BY7;EF85
CV1376	6BX6;EF80
CV1377	5AR4;GZ34
CV1449	DCG5/5000GB;872A
CV1453	4378
CV1535	6V4;EZ80
CV1625	DCG4/1000ED; RG3-250
CV1629	DCG4/5000
CV1741	6CA7;EL34
CV1787	4C35A
CV1795	723A/B
CV1832	OA2;150C2;150C4
CV1833	OB2
CV1835	DCX4/1000;3B28
CV1836	1163
CV1838	QQC04/15;5895
CV1862	6AQ5;EL90
CV1865	EC81;6R4
CV1866	JP9-7D
CV1886	EC80;6Q4
CV1888	EC81;6R4
CV1905	QB3/200;4-65A

CV number	Comparable type
CV1924	TB2.5/300;5866
CV1949	EN93;6D4
CV1977	45A4;UL41
CV1992	PL1267/Z300T
CV2101	DF72
CV2103	DF73
CV2105	6373;DL70
CV2127	EL821;6CH6
CV2128	6AJ8;ECH81
CV2129	QE03/10;5763;M8096
CV2130	QB3/300;6155
CV2131	QB3.5/750;6156
CV2132	90AV
CV2133	90CG
CV2134	90CV
CV2175	DCG7-3ALP1
CV2191	DG13-2
CV2210	PL5544
CV2215	PL5545A
CV2225	150B2;6354
CV2238	5672
CV2241	5642;DY70
CV2253	PL6574
CV2254	DF60;5678
CV2271	Z303C
CV2275	DC70;6375
CV2284	(4J50)
CV2295	QQV5-P10;3E29
CV2302	DH3-91;1CP31
CV2325	Z502S
CV2331	DL64
CV2348	4068
CV2361	DL69
CV2371	DF61N
CV2382	EL822
CV2399	RR3-1250A
CV2420	JPT9-01
CV2431	3AMP1
CV2432	6205
CV2433	DF63
CV2434	Z803U;6779
CV2454	75C1
CV2466	QQE02/5;6939
CV2487	QEL2/250;4X250B
CV2492	6922;E88CC
CV2516	2C39A
CV2518	DCX4/5000;4B32
CV2519	QEL1/150;4X150A
CV2520	6279;5C22
CV2524	6AU6;EF94
CV2526	EBC91;6AV6
CV2573	5651
CV2634	367
CV2642	417A;5842
CV2662	5639
CV2718	1876
CV2721	EL81;6CJ6
CV2726	6CK6;EL83
CV2729	6084;E80F
CV2730	4066
CV2753	PL5684/C3JA
CV2792	2K25
CV2797	QQE06/40;5894
CV2798	QQE03/12;6360
CV2799	QQE03/20;6252
CV2876	PL5727;M8204
CV2896	52CG
CV2901	6267;EF86
CV2927	EC50
CV2940	6CM5;EL36

CV number	Comparable type
CV2957	PL5557
CV2963	QB3/300GA;4-125A
CV2964	QB3.5/750GA;4-250A
CV2966	EY87;652A
CV2967	8020
CV2975	EL84;6BQ5
CV2980	1M3;DM70
CV3508	M8162;E81CC; 6201;12AT7WA
CV3512	5696;EN92
CV3521	5949
CV3522	6079;QB5/1750
CV3523	QE05/40;6146
CV3526	EL85;6BN5
CV3528	(YJ1110)
CV3560	(2J51A)
CV3599	QQV5-P10;3E29
CV3602	5J26
CV3611	5586
CV3676	2J42
CV3789	5842;417A
CV3879	QB4/1100GA;4-400A
CV3882	EBC41;6CV7
CV3883	EAF42;6CT7
CV3884	ECC40
CV3885	EF40
CV3886	EF41;6CJ5
CV3887	EF42
CV3888	ECH42;6CU7
CV3889	6CK5;EL41
CV3890	EL42
CV3891	EZ40;6BT4
CV3892	AZ41
CV3893	4X150G;QV1-150G
CV3905	5847
CV3926	TBL6/6000;5924
CV3928	5636;EF730
CV3929	EF732;5840
CV3930	EC71;5718
CV3933	5783WA
CV3946	3WP1;DG7-36
CV3960	5783WA;M8190
CV3986	6021;ECC70
CV3987	5644
CV3990	2E26;QV05-10
CV3991	4X150D
CV3997	YJ1110
CV3998	E180F;6688
CV4003	M8136;6189 12AU7WA
CV4004	M8137
CV4007	5726;E91AA; 6AL5W;M8212
CV4008	5719
CV4009	5749;6BA6W
CV4010	6AK5W;E95F; 5654;M8100
CV4011	6AS6W;5725;M8196
CV4014	M8083
CV4015	M8161
CV4017	5751
CV4018	PL5727;M8204
CV4019	M8245
CV4020	M8223;OA2WA
CV4024	6201;E81CC; 12AT7WA;M8126
CV4025	5726;E91AA;M8079
CV4028	OB2WA;M8224
CV4029	5902

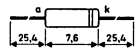
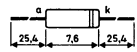
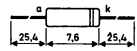
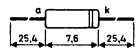
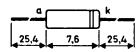
CV number	Comparable type
CV4031	M8081
CV4039	M8214
CV4048	M8098
CV4058	M8080
CV4063	M8082
CV4066	M8190;5783W
CV4070	M8099
CV4080	M8225
CV4085	M8195
CV4100	M8223;OA2WA
CV4101	M8224;OB2WA
CV4104	M8163
CV4108	E188CC;7308
CV5018	4J52A
CV5035	DG13-34;5ADP1
CV5037	6BA6W;5749
CV5055	6DA5;EM81
CV5072	6CA4;EZ81
CV5077	PL81;21A6
CV5079	5643
CV5094	6CW5;EL86
CV5106	6370;E1T
CV5120	20CV
CV5122	Z900T;5823
CV5123	JP9-15D
CV5125	DP13-34
CV5132	M8163
CV5134	2J51A
CV5140	6923;EA52
CV5144	PCL83
CV5156	6DA6;EF89
CV5157	DP13-2
CV5171	DP7-5;3ALP7
CV5173	90C1
CV5186	5651
CV5188	7119;E182CC
CV5189	5726;6AL5W; E91AA;M8212
CV5190	M8245
CV5212	12AT7WA;E81CC; 6201;M8162
CV5214	5920;E90CC
CV5215	6BL8;ECF80
CV5216	6AK5W;E95F; 5654;M8100
CV5231	7308;E188CC
CV5232	C3m
CV5234	XR1-1600A;8063
CV5247	4C35A
CV5269	DG7-6
CV5277	6700;ET51
CV5278	Z510M
CV5281	6CW7;ECC84
CV5311	M8248
CV5331	ECC189;6ES8
CV5358	6DJ8;ECC88
CV5397	EC157;8108
CV5724	E80T;6218
CV5900	KS7-85A
CV5915	ECH21
CV6007	3C45
CV6072	JP8-02B
CV6087	LA9-3B
CV6215	YJ1100
CV6223	LB3-250B
CV6225	YJ1030
CV8505	(YJ1040)

REPLACEMENT GUIDE FOR ELECTRON TUBES

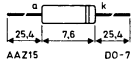
CV number	Comparable type
CV8652	YJ1010
CV9334	KS9-20B
CV9424	YJ1200
CV10758	JP9-2.5E

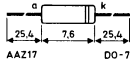
SEMICONDUCTORS
AND
INTEGRATED CIRCUITS

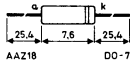
LOW POWER DIODES

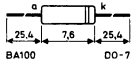
Type and applications	*Ratings* (mA)	(V)	(°C)	$R_{th\,j-a}$ (°C/mW)	V_F at I_F (V)	(mA)	I_R at V_R (μA)	(V)	*Char.*	*Outlines* (mm)
AA119	I_F = 35		T_{amb} = 60	0,65	T_{amb} = 60°C		T_{amb} = 60°C		matched	
AM/FM detector	I_{FRM} = 100				0.16	0.1	4.5	0.1	pair	
germanium	V_R = 30		T_{stg} = +75		0.50	1.0	16	10	2-AA119	
point contacted	V_{RRM} = 45				2.6	30	170	45		
AAY21	I_F = 20		T_{amb} = 60	0.75	T_j = 60°C		T_j = 60°C		C_d < 1.2 pF	
switch	I_{FM} = 50		T_j = 75		0.27	2	18	5		
germanium	V_R = 15				0.53	10	40	15		
point contacted			T_{stg} = +75		0.95	50				
AAY30	I_F = 110		T_j = 75	0,55	T_j = 60°C		T = 60°C		C_d < 1.0 pF	
switch	I_{FRM} = 400				< 0.14	0.1	< 40	1.5	Q_s < 500 pC	
germanium	V_R = 30		T_{stg} = +75		< 0.41	10	< 60	10		
gold bonded	V_{RRM} = 50				< 0.99	150	< 500	50		
AAY32	I_F = 110		T_j = 85	0,55	T_j = 60°C		T_j = 60°C		C_d < 1.5 pF	
switch	I_{FRM} = 150				< 0.14	0.1	< 15	1.5	Q_s < 150 pC	
germanium	V_R = 30		T_{stg} = +85		< 0.41	10	< 30	10		
gold bonded	V_{RRM} = 30				< 0.99	150	< 200	30		
AAZ13	I_F = 30		T_j = 75	0,55	T_{amb} = 25°C		T_{amb} = 60°C		C_d = 3.3 pF	
fast switch	I_{FRM} = 100				0.27	1	30	3	Q_s = 20 pC	
germanium	V_R = 8		T_{stg} = +75		0.50	10	190	8		
gold bonded					0.60	30				

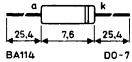
AAZ15 switch germanium gold bonded	I_F = 140 I_{FRM} = 250 V_R = 75 V_{RRM} = 100	T_j = 85 T_{stg} = +85	0,55	T_j = 60 °C <0.15 0.1 <0.40 10 <1.07 250	T_j = 60 °C <30 1.5 <80 50 <300 100	C_d < 2 pF Q_s < 1800 pC
AAZ17 switch germanium gold bonded	I_F = 140 I_{FRM} = 250 V_R = 50 V_{RRM} = 75	T_j = 85 T_{stg} = +85	0,55	T_j = 60 °C <0.15 0.1 <0.40 10 <1.07 250	T_j = 60 °C <30 1.5 <300 50 <500 75	C_d < 2 pF Q_s < 900 pC
AAZ18 switch germanium gold bonded	I_F = 130 I_{FRM} = 300 V_R = 20 V_{RRM} = 20	T_j = 75 T_{stg} = +75	0.55	T_j = 60 °C <0.14 0.1 <0.36 10 <0.76 150	T_j = 60 °C <30 1.5 <45 10 <100 20	C_d < 2.5 pF
BA100 general purposes silicon junction	I_F = 90 I_{FRM} = 100 I_{FSM} = 200 V_R = 60	T_j = 90 T_{stg} = +90	0.4	T_{amb} = 60 °C 0.5 0.1 0.6 1.0 0.85 30	T_{amb} = 75 °C < 10 10 <20 60	—
BA114 stabilizer silicon alloyed	I_F = 20 T_{amb} = 90 T_{stg} = +90		0.4	T_{amb} = 25 °C <0.56 0.1 <0.7 1 <1.05 20	—	—
BA216 stabiliser silicon oxide passivated	I_F = 75 I_{FRM} = 150 I_{FSM} = 1000 V_{RRM} = 10	T_j = 200 T_{stg} = +200	0.60	T_j = 25 °C 0.5 0.2 0.62 0.2 0.7 15 1 15	T_j = 25 °C 1.5 10	C_d < 3 pF t_{rr} < 4 ns

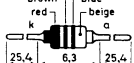






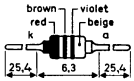




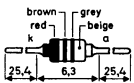


LOW POWER DIODES

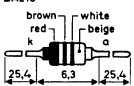
Type and applications	Ratings (mA)	(V)	($^\circ C$)	$R_{th\,j-a}$ ($^\circ C/mW$)	V_F at I_F (V)	(mA)	I_R at V_R (μA)	(V)	Char.	Outlines (mm)
BA217	I_F = 75	T_j = 200		0.60	T_j=25°C		T_j=25°C		C_d < 3 pF	
general purpose	I_{FRM} = 150				0.7	1	< 0.05	10	t_{rr} < 4 ns	
silicon	I_{FSM} =2000	T_{stg} = +200			1.0	10	< 0.2	30		
oxide passivated	V_{RRM} = 30				1.5	50				
BA218	I_F = 75	T_j = 200		0.60	T_j=25°C		T_j=25°C		C_d < 3 pF	
general purpose	I_{FRM} = 150				0.7	1	< 0,05	25	t_{rr} < 4 ns	
silicon	I_{FSM} =2000	T_{stg} = +200			1.0	10	< 0,2	50		
oxide passivated	V_{RRM} = 50				1.5	50				
BA219	I_F = 100	T_j = 200		0.60	T_j=25°C		T_j=25°C		C_d < 5 pF	
general purpose	I_{FRM} = 300				0.65	1	< 0,2	50	t_{rr} < 120 ns	
silicon	I_{FSM} =2000	T_{stg} = +200			0.85	10	< 0,5	100		
oxide passivated	V_{RRM} = 100				1.4	100				
BA220	I_F = 200	T_j = 200		0.5	T_j=25°C		T_j=25°C		C_d < 2,5 pF	
general purpose	I_{FRM} = 400				<0.52	0.1	< 1,5	10	t_{rr} < 4 ns	
silicon	I_{FSM} =4000	T_{stg} = +200			<0.62	1				
planar epitaxial	V_{RRM} = 10				<0,75	10				
					<0,95	100				
BA221	I_F = 200	T_j = 200		0.5	T_j=25°C		T_j=25°C		C_d < 2,5 pF	
general purpose	I_{FRM} = 400				<0.625	1	<0,025	10	t_{rr} < 4 ns	
silicon	I_{FSM} =4000	T_{stg} = +200			<0.95	100	< 0,2	30		
planar epitaxial	V_{RRM} = 30				<1.05	200				



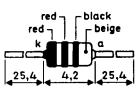
BA217



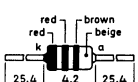
BA218



BA219

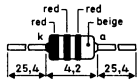


BA220 DO-35

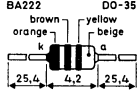


BA221 DO-35

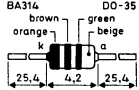
BA222	I_F = 75	T_j = 200	0.6	T_j=25°C		T_j=25°C	C_d < 2 pF
general purpose	I_{FRM} = 150			<0.7	1	< 0,05 25	t_{rr} < 4 ns
silicon	I_{FSM} =2000	T_j = +200		<0.9	10	< 0,2 50	
planar epitaxial	V_{RRM}= 50			<1.1	50		
BA314	I_{FRM} = 250	T_j = 200	0,38	T_j=25°C		T_j=25°C	C_d < 140 pF
low voltage		T_{stg} = +200		0,65	0,1	< 5 4	S_F = −1,3 mV/°C
stabistor				0,72	1		
silicon				0,79	10		
planar epitaxial				0,92	100		
BA315	I_{FRM} = 225	T_j = 200	0,6	T_j=25°C		T_j=25°C	C_d < 3 pF
low voltage		T_{stg} = +200		0,51	0,1	< 1,5 5	S_F = −2,1 mV/°C
stabistor				0,63	1		
silicon				0,75	10		
planar epitaxial				0,98	100		
BA316	I_F = 100	T_j = 200	0,6	T_j=25°C		T_j=25°C	C_d < 3 pF
general purpose	I_{FRM} = 225			<0,7	1	< 0,2 10	t_{rr} < 4 ns
silicon	I_{FSM} =2000	T_{stg} = +200		<0,85	10		
planar epitaxial	V_R = 10			<1,1	100		
BA317	Equivalent to BA316 except for:						
	V_R = 30			<0,2	30		
BA318	Equivalent to BA316 except for:						
	V_R = 50			<0,2	50		
BAV10	I_F = 300	T_j = 200	0,5	T_j=25°C		T_j=25°C	C_d < 2.5 pF
high speed switch	I_{FRM} = 600			0,75	10	0,1 60	t_{rr} < 6 ns
silicon	I_{FSM} =4000	T_{stg} = +200		1,0	200	T_{amb}=150°C	Q_s < 50 pC
planar epitaxial	V_{RRM}= 60			1,25	500	100 60	



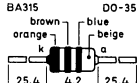
BA222 DO-35



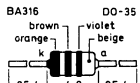
BA314 DO-35



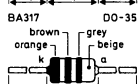
BA315 DO-35



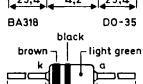
BA316 DO-35



BA317 DO-35



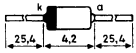
BA318 DO-35



BAV10 DO-35

LOW POWER DIODES

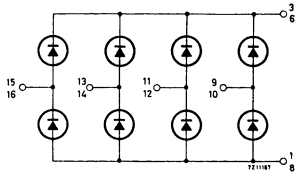
Type and applications	*Ratings* (*mA*) (*V*) (°C)	$R_{th\ j-a}$ (°C/mW)	V_F at I_F (*V*) (*mA*)	I_R at V_R (*μA*) (*V*)	*Char.*	*Outlines* (*mm*)
BAV18 general purpose silicon planar epitaxial	I_F = 250 T_j = 175 I_{FRM} = 625 I_{FSM} = 1000 T_{stg} = +175 P_{tot} = 400 mW V_R = 50	0,38	T_j = 25°C < 1 100	T_j = 25°C < 0,1 50 T_j = 150°C 100 50	C_d < 5 pF t_{rr} < 50 ns	
BAV19	Equivalent to BAV18 except for: V_R = 100			T_j = 25°C < 0,1 100 T_j = 150°C 100 100		
BAV20	Equivalent to BAV18 except for: V_R = 150			T_j = 25°C < 0,1 150 T_j = 150°C 100 150		
BAV21	Equivalent to BAV18 except for: V_R = 200			T_j = 25°C < 0,1 200 T_j = 150°C 100 200		



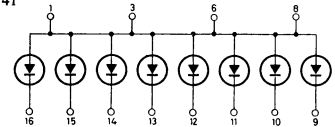
BAV18 to 21 DO-35

	individual					
BAV40	I_F = 300	T_j = 150	0.08	$T_j = 25°C$	$T_j = 25°C$	$C_d < 3$ pF
fast switch	I_{FRM} = 600		(all diodes	<0.75 10	<0.4 60	$Q_s < 50$ pC
array of 8	I_{FSM} = 4000	$T_{stg} = +150$	dissipating)	<1.05 200	$T_j = 150°C$	$t_{rr} < 6$ ns
silicon planar	V_R = 60			<1.3 500	<400 60	
epitaxial diodes	V_{RRM} = 60			<1.6 800		
	individual diode					
BAV41	I_F = 300	T_j = 150	0.08	$T_j = 25°C$	$T_j = 25°C$	$C_d < 3$ pF
fast switch	I_{FRM} = 600		(all diodes	<0.75 10	<0.1 60	$Q_s < 50$ pC
array of 8	I_{FSM} = 4000	$T_{stg} = +150$	dissipating)	<1.05 200	$T_j = 150°C$	$t_{rr} < 6$ ns
silicon planar	V_R = 60			<1.3 500	<100 60	
epitaxial diodes	V_{RRM} = 60			<1.6 800		
	individual diode					
BAV42	I_F = 300	T_j = 150	0.08	$T_j = 25°C$	$T_j = 25°C$	$C_d < 3$ pF
fast switch	I_{FRM} = 600		(all diodes	<0.75 10	<0.1 60	$Q_s < 50$ pF
array of 8	I_{FSM} = 4000	$T_{stg} = +150$	dissipating)	<1.05 200	$T_j = 150°C$	$t_{rr} < 6$ ns
silicon planar	V_R = 60			<1.3 500	<100 60	
epitaxial diodes	V_{RRM} = 60			<1.6 800		

BAV40

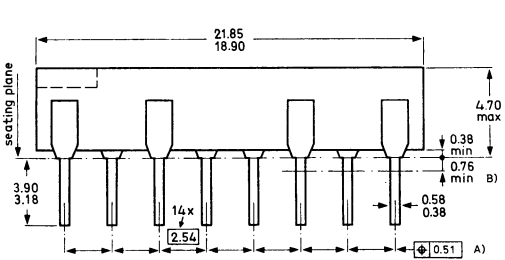


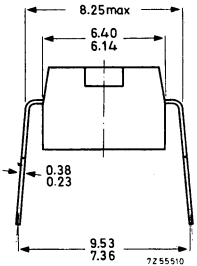
BAV41

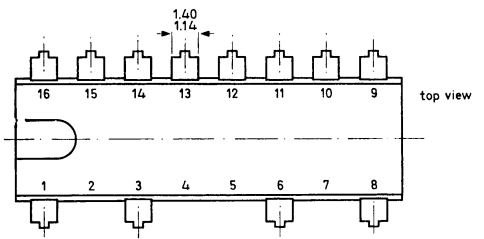


LOW POWER DIODES

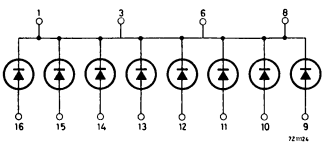
Plastic dual in-line for BAV40; BAV41; BAV42; BAV43



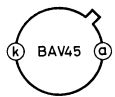
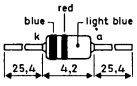
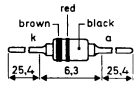




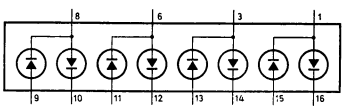
BAV42



Dimensions in mm

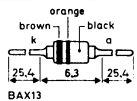
Type and applications	*Ratings* (mA)	(V)	(°C)	$R_{th\,j-a}$ (°C/mW)	V_F at I_F (V)	(I_F in mA)	I_R at V_R (I_R in μA)	(V_R in V)	*Char.*	*Outlines* (mm)
BAV43	individual diode									
fast switch	I_F = 300	T_j = 150		0.08	T_j = 25°C		T_j = 25°C		C_d < 3 pF	
array of 8	I_{FRM} = 600			(all diodes	< 0.75	10	< 0.1	60	Q_s < 50 pC	
silicon planar	I_{FSM} = 4000	T_{stg} = +150		dissipating)	< 1.05	200	T_j = 150°C		t_{rr} < 6 ns	
epitaxial diodes	V_R = 60				< 1.3	500	< 100	60		
	V_{RRM} = 60				< 1.6	800				
BAV45	I_F = 50	T_j = 125		0.5	T_j = 25°C		T_j = 25°C		C_d < 1.3	
clamping, holding,	I_{FRM} = 100				< 1.0	10	< 5 pA	5	t_{rr} < 350 ns	
peak follower,	V_R = 20	T_{stg} = +125					< 10 pA	20		
time delay circuits	V_{RRM} = 35						T_j = 80°C			
log. amplifiers							< 250 pA	5		
BAW62	I_F = 100	T_j = 200		0.6	T_j = 25°C		T_j = 150°C		C_d < 2 pF	
fast switch	I_{FRM} = 225				< 0.75	5	< 50	20	Q_s < 50 pC	
silicon	V_R = 75	T_{stg} = +200			< 1.0	100	< 100	75	t_{rr} < 4 ns	
planar epitaxial	V_{RRM} = 75									
BAX12	I_F = 400	T_j = 200		0.3	T_j = 25°C		T_j = 150°C		C_d < 35 pF	
switch	I_{FRM} = 800				< 0.75	10	50	90	Q_s < 0.5 nC	
silicon	I_{FSM} = 6000	T_{stg} = +200			< 0.90	100	< 100	90	t_{rr} < 50 ns	
whiskerless	V_R = 90				< 1.25	400				

BAV43

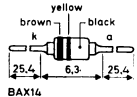


LOW POWER DIODES

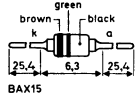
Type and applications	*Ratings* (mA)	(V)	(°C)	$R_{th\,j-a}$ (°C/mW)	V_F at I_F (V)	(mA)	I_R at V_R (μA)	(V)	*Char.*	*Outlines* (mm)
BAX13	I_F = 75		T_j = 200	0.6	T_j = 25°C		T_j = 150°C		C_d < 3 pF	
fast switch	I_{FRM} = 150				< 0.7	2	< 10	10	Q_s < 45 pC	
silicon	V_R = 50		T_{stg} = +200		< 1.0	20	< 25	50	t_{rr} < 4 ns	
whiskerless	V_{RRM} = 50				< 1.53	75				
BAX14	I_F = 300		T_j = 200	0,4	T_j = 25°C		T_j = 25°C		C_d < 35 pF	
general purpose	I_{FRM} = 600				< 0,6	1	< 0,1 A	20	t_{rr} < 50 ns	
	V_R = 20		T_{stg} = +200		< 1,1	300				
	V_{RRM} = 40									
BAX15	I_F = 250		T_j = 200	0.4	T_j = 25°C		T_j = 100°C		C_d < 20 pF	
general purpose	I_{FRM} = 500				< 1.0	100	< 10	150	Q_s = 1 nC	
silicon	V_R = 150		T_{stg} = +200		< 1.35	250			t_{rr} < 300 ns	
whiskerless	V_{RRM} = 180									
BAX16	I_F = 200		T_j = 200	0.4	T_j = 25°C		T_j = 150°C		C_d < 10 pF	
general purpose	I_{FRM} = 300				< 0.65	1	< 25	50	Q_s < 0.7 nC	
silicon	V_R = 150		T_{stg} = +200		< 1.3	100	< 100	150	t_{rr} < 120 ns	
whiskerless	V_{RRM} = 150				< 1.5	200				
BAX17	I_F = 200		T_j = 200	0.4	T_j = 25°C		T_j = 150°C		C_d < 10 pF	
general purpose	I_{FRM} = 300				< 0.65	1	< 25	50	Q_s < 0.7 nC	
silicon	V_R = 200		T_{stg} = +200		< 1.1	100	< 100	200	t_{rr} < 120 ns	
whiskerless	V_{RRM} = 200				< 1.2	200				



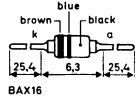
BAX13



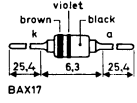
BAX14



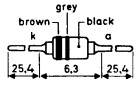
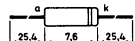
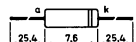
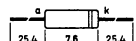
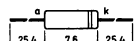
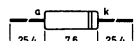
BAX15



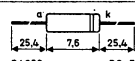
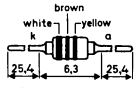
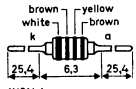
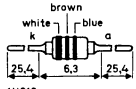
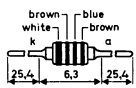
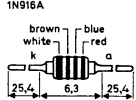
BAX16



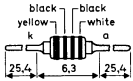
BAX17

BAX18 general purpose silicon whiskerless	I_F = 500 I_{FRM} = 2000 I_{FSM} = 6000 V_{RRM} = 175	T_j = 200 T_{stg} = +200	0.3	T_j = 150 °C < 2.0 2000	T_j = 150 °C < 100 75		 BAX18
OA47 switch germanium gold bonded	I_F = 110 I_{FRM} = 150 V_R = 25 V_{RRM} = 25	T_j = 75 T_{stg} = +75	0,55	T_j = 60 °C < 0.14 0.1 < 0.43 10 < 1.1 150	T_j = 60 °C < 20 1.5 < 90 20 < 160 25	C_d < 3.5 pF Q_s < 600 pC	 OA47 DO-7
OA90 video detector germanium point contacted	I_F = 8 I_{FRM} = 45 V_R = 20 V_{RRM} = 30	T_{amb} = 75 T_{stg} = +90	—	T_{amb} = 60 °C 0.12 0.1 0.95 10 1.95 30	T_{amb} = 60 °C 11 1.5 45 10 400 30	—	 OA90 DO-7
OA91 general purposes germanium point contacted	I_F = 50 I_{FRM} = 150 V_R = 90 V_{RRM} = 115	T_{amb} = 75 T_{stg} = +75	0,55	T_{amb} = 60 °C 0.1 0.1 1.05 10 1.9 30	T_{amb} = 60 °C 15 1.5 20 10 190 100	—	 OA91 DO-7
OA95 general purposes germanium point contacted	I_F = 50 I_{FRM} = 150 V_R = 90 V_{RRM} = 115	T_{amb} = 75 T_{stg} = +75	0,55	T_{amb} = 60 °C 0.1 0.1 0.95 10 1.75 30	T_{amb} = 60 °C 12 1.5 17 10 200 100	—	 OA95 DO-7
OA200 general purposes silicon junction	I_F = 160 I_{FRM} = 250 V_R = 50	T_{amb} = 125 T_{stg} = +125	0.4	T_{amb} = 125 °C < 0.30 0.1 < 0.65 10 < 0.80 30	T_{amb} = 125 °C 1 50 T_{amb} = 25 °C 0.02 50	C_d = 10 pF	 OA200 DO-7

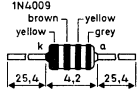
LOW POWER DIODES

Type and applications	Ratings (mA) (V) (°C)	$R_{th\,j-a}$ (°C/mW)	V_F at I_F (V) (mA)	I_R at V_R (μA) (V)	Char.	Outlines (mm)
OA202 general purposes silicon junction	I_F = 160 I_{FRM} = 250 V_R = 150 T_{amb} = 125 T_{stg} = +125	0.4	T_{amb} = 125°C <0.30 0.1 <0.65 10 <0.80 30	T_{amb} = 125°C 0.5 150 T_{amb} = 25°C 0.01 150	C_d = 10 pF	 OA202 DO-7
1N914 high speed silicon whiskerless	I_F = 75 I_{FRM} = 225 V_R = 75 V_{RRM} = 100 T_{amb} = 175 T_{stg} = +200	—	T_j = 25°C <1 10	T_j = 25°C <5 75 T_j = 150°C <50 20	C_d < 4 pF t_{rr} < 4 ns	 1N914
1N914A	Equivalent to 1N914 except for:		<1 20	band 4 added: brown		 1N914A
1N916 high speed silicon whiskerless	I_F = 75 I_{FRM} = 225 V_R = 75 V_{RRM} = 100 T_{amb} = 175 T_{stg} = +200	—	T_j = 25°C <1 10	T_j = 25°C <5 75 T_j = 150°C <50 20	C_d < 2 pF t_{rr} < 4 ns	 1N916
1N916A	Equivalent to 1N916 except for:		<1 20	band 4 added: brown		 1N916A
1N916B	Equivalent to 1N916 except for:		<1 30	band 4 added: red		 1N916B

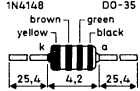
1N4009	V_R = 25	T_{stg} = +200	0.6	T_{amb} = 25°C	T_{amb} = 25°C	C_d < 4 pF
general purpose	P_{tot} = 250 mW			< 1 30	< 0.1 25	t_{rr} < 4 ns
ultra high speed					T_{amb} = 150°C	
silicon					< 100 25	
1N4148	I_F = 75	T_j = 200		T_j = 25°C	T_j = 150°C	C_d < 4 pF
ultra high speed	I_{FRM} = 225			< 1.0 10	< 50 20	t_{rr} < 4 ns
silicon	V_R = 75	T_{stg} = +200				
whiskerless	V_{RRM} = 75					
1N4150	I_F = 300	T_j = 200		T_j = 25°C	T_j = 25°C	C_d < 2.5 pF
general purpose	I_{FRM} = 600			< 0.62 1	< 0.1 50	t_{rr} < 6 ns
silicon	I_{FSM} = 4000	T_{stg} = +200		< 0.74 10	T_{amb} = 150°C	
whiskerless	V_R = 50			< 0.92 100	< 100 50	
				< 1 200		
1N4151	I_F = 200	T_j = 200		T_j = 25°C	T_j = 25°C	C_d < 2 pF
military; industrial	I_{FRM} = 450			< 1 50	< 0.05 50	t_{rr} < 4 ns
silicon	V_R = 50	T_{stg} = +200			T_{amb} = 150°C	
whiskerless	V_{RRM} = 75				< 50 50	
1N4154	I_F = 200	T_j = 200		T_j = 25°C	T_j = 25°C	C_d < 4 pF
military; industrial	I_{FRM} = 450			< 1 30	< 0.1 25	t_{rr} < 4 ns
silicon	V_R = 25	T_{stg} = +200			T_{amb} = 150°C	
whiskerless					< 100 25	
1N4446	Equivalent to 1N4148 except for:			T_j = 25°C		
	I_F = 200	I_{FRM} = 450		< 1.0 20		
1N4448	Equivalent to 1N4446 except for:			T_j = 25°C	T_j = 100°C	
				< 1.0 100	< 3 20	



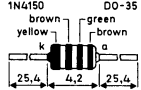
1N4009



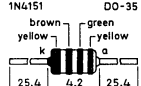
1N4148 DO-35



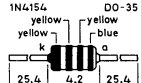
1N4150 DO-35



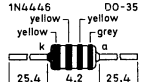
1N4151 DO-35



1N4154 DO-35

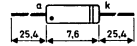
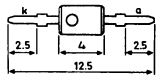
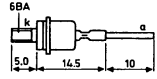
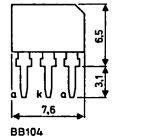


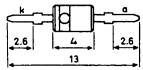
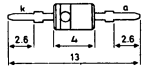
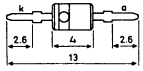
1N4446 DO-35



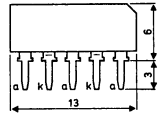
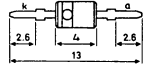
1N4448 DO-35

TUNER DIODES

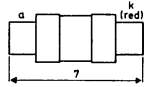
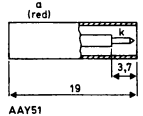
Type and applications	*Ratings* (mA) (V)	(W) (°C)	R_{th} (°C/W)	I_R at V_R (μA) (V)	*Characteristics*	*Outlines* (mm)
BA102 variable capacitance silicon	$I_R = 0.1$ $V_R = 20$	$T_j = 90$ $T_{stg} = +90$	$R_{th\,j-a} =$ 500	$T_j = 80°C$ <5 20	$\frac{C_d(V_R = 10\ V)}{C_d(V_R = 4\ V)} < 0.7$ at $f \leqslant 300$ MHz $r_D < 3\ \Omega$ at $V_R = 4$ V	 BA102 DO-7
BA182 switch silicon planar	$I_F = 100$ $V_R = 35$	$T_j = 100$ $T_{stg} = 100$	$R_{th\,j-a} =$ 400	$T_j = 60°C$ 50 pA 1 0,3 mA 10 1,1 nA 35	$V_F < 1{,}2$ V at $I_F = 100$ mA $C_d < 1$ pF at $V_R = 20$ V; $f = 1$ MHz $r_D < 0{,}7\ \Omega$ at $I_F = 5$ mA $f = 200$ MHz	 BA182
BAY66 varactor silicon double diffused	$I_{FRM} = 400$ $V_R = 100$ $P_{tot} = 12$	$T_j = 150$ $T_{stg} = +150$	$R_{th\,j-a} =$ 120 $R_{th\,j-mb} =$ 10	$T_j = 25°C$ <10 100 $T_j = 150°C$ <200 100	$C_d = 65$ pF at $V_F = 0.5$ V $C_d = 25$ pF at $V_R = 0$ $C_d < 6$ pF at $V_R = 100$ V $r_D < 2.0\ \Omega$ at $V_R = 48$ V; $f = 200$ MHz	 BAY66
BB104B variable capacitance double diode silicon planar f.m. tuner	$I_F = 100$ $V_R = 30$	$T_j = 100$ $T_{stg} = +100$	0.6	$T_j = 25°C$ <0.02 30 $T_j = 60°C$ <0.2 30	$C_d > 37$ pF, $C_d < 42$ pF } $f = 1$ MHz, $V_R = 3$ V $C_d = 14$ pF $V_R = 30$ V $\frac{C_d(V_R = 3\ V)}{C_d(V_R = 30\ V)} = 2.65$ at $f = 1$ MHz $r_D = 0.3\ \Omega$ at $f = 100$ MHz	 BB104

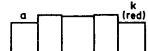
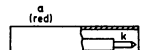
BB104G	Equivalent to BB104B except for:				$C_d > 34$ pF } at $f = 1$ MHz $C_d < 39$ pF } $V_R = 3$ V	
12-BB105A variable capacitance silicon planar u.h.f. tuner	$I_F = 20$ $V_R = 28$ $V_{RM} = 30$	$T_j = 60$ $T_{stg} = +100$	$R_{th\,j-a} =$ 400	$T_j = 25°C$ <0.1 28 $T_j = 60°C$ <0.5 28	$C_d = 11.5$ pF at $V_R = 3$ V; $f = 1$ MHz $C_d = 2.3$ to 2.8 pF at $V_R = 25$ V; $f = 1$ MHz $r_D = 0.4\ \Omega$ at $I_F = 5$ mA; $f = 200$ MHz	 12-BB105
12-BB105B	Equivalent to 12-BB105A except for:				$C_d = 2.0$ to 2.3 pF at $V_R = 25$ V; $f = 1$ MHz	
12-BB105G	Equivalent to 12-BB105A except for:				$C_d = 1.8$ to 2.8 pF at $V_R = 25$ V; $f = 1$ MHz	
3-BB106 **4-BB106** variable capacitance silicon planar v.h.f. tuner	$I_F = 20$ $V_R = 28$ $V_{RM} = 30$	$T_j = 60$ $T_{stg} = +100$	$R_{th\,j-a} =$ 400	$T_j = 25°C$ <0.05 28 $T_j = 60°C$ <0.2 28	$C_d > 20$ pF at $V_R = 3$ V; $f = 0.5$ MHz $C_d = 4.0$ to 5.6 pF at $V_R = 25$ V; $f = 0.5$ MHz $r_D = 0.4\ \Omega$ at $C_d = 25$ pF; $f = 200$ MHz	 12-BB106
BB110B variable capacitance silicon planar f.m. tuner	$I_F = 100$ $V_R = 30$	$T_j = 100$ $T_{stg} = +100$	0.4	$T_j = 25°C$ <0.02 30 $T_j = 60°C$ <0.2 30	$C_d > 29$ pF } at $f = 1$ MHz $C_d < 33$ pF } $V_R = 3$ V $C_d = 11$ pF at $V_R = 30$ V $\frac{C_d(V_R = 3\text{ V})}{C_d(V_R = 30\text{ V})} = 2.65$ at $f = 1$ MHz $r_D = 0.3\ \Omega$ at $f = 100$ MHz	 BB110

TUNER DIODES

Type and applications	Ratings I_F (mA)	V_R (V)	T_j (W)	T_{stg} (°C)	R_{th} (°C/W)	I_R at V_R (μA) (V)	Characteristics	Outlines (mm)
BB110G	Equivalent to BB110B except for:						$C_d > 27$ pF } at $f = 1$ MHz $C_d < 31$ pF } $V_R = 3$ V	
BB113 triple variable capacitance a.m. radio each diode	$I_F = 50$ $V_R = 32$		$T_j = 85$ $T_{stg} = 85$			$T_{amb} = 25°C$ < 50 nA 32 $T_{amb} = 60°C$ < 200 nA 32	$C_d = 290$ pF at $V_R = 0{,}5$ V $C_d <$ 13 pF at $V_R = 30$ V $r_D <$ 4 Ω at $C_d = 200$ pF $f = 0{,}5$ MHz	 BB113
BB117 variable capacitance silicon planar freq. control	$I_F = 20$ $V_R = 20$		$T_j =$ 60 $T_{stg} = +100$		0.4	$T_j = 25°C$ <0.1 20 $T_j = 60°C$ <0.5 20	C_d at $f = 0{,}5$ MHz $C_d = 2{,}2$ to 4 pF; $V_R = 15$ V $C_d = 8$ to 11 pF; $V_R = 4$ V $\frac{C_d(V_R = 4\text{ V})}{C_d(V_R = 15\text{ V})} = 2$ to 5 at $f = 0.5$ MHz $r_D < 1.2$ Ω at $f = 470$ MHz	 BB117

MICROWAVE DEVICES

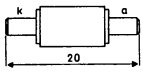
Type and applications	*Characteristics*	*Ratings*	*Outlines (mm)*
AAY39 germanium low noise mixer at X-band	$I_R = 3$ μA at $V_R = 0{,}5$ V $I_F = 5$ mA at $V_F = 0{,}5$ V F < 6,5 dB Conversion loss = 4,2 dB $Z_{if} > 250\ \Omega$ and $< 450\ \Omega$ f 1 to 18 GHz	D.C. spike = 0,1 erg R.F. spike = 0,05 erg $P_{tot} = 0{,}5$ W $T_{stg} = +100°C$ $T_{amb} = 100°C$	cathode marked red  AAY39
AAY39A	Equivalent to AAY39 except for: $F < 7{,}5$ dB; Conversion loss = 5 dB		 AAY51
AAY51 germanium balanced mixer circuits at J-band	$I_R = 3$ μA at $V_R = 0{,}5$ V $I_F = 9$ mA at $V_F = 0{,}5$ V $F < 7{,}5$ dB Conversion loss = 5,2 dB $Z_{if} > 220\ \Omega$ and $< 320\ \Omega$ f 12 to 18 GHz	D.C. spike = 0,1 erg $T_{stg} = +100°C$ $T_{amb} = 100°C$	Pin cathode Body (red) anode
AAY51R	Equivalent to AAY51 except for: reverse polarity		Pin anode Body (blue) cathode
AAY52	Equivalent to AAY51 except for: $F < 8{,}5$ dB		
AAY52R	Equivalent to AAY51 except for: $F < 8{,}5$ dB and reverse polarity (see AAY51R)		

Type and applications	*Characteristics*	*Ratings*	*Outlines (mm)*
AAY59 germanium mixer diode at Q-band	$I_R = 2\ \mu A$ at $V_R = 0{,}5$ V $I_F = 2$ mA at $V_F = 0{,}5$ V $F < 10$ dB Conversion loss = 5,5 dB $Z_{if} > 700\ \Omega$ and $< 1400\ \Omega$ f 26 to 40 GHz	R.F. spike = 0,03 erg P_{tot} (peak) = 0,5 W $T_{stg} = +100°C$ $T_{amb} = 100°C$	cathode marked red  AAY59
AEY29 germanium backward diode low level detector at J-band	$I_R = 100\ \mu A$ at $V_R = 0{,}3$ V $I_F = 12$ mA at $V_F = 0{,}3$ V tangential sensitivity = -43 dBm $Z_{iv} = 300\ \Omega$	$T_{stg} = +100°C$ $T_{amb} = 100°C$	 AEY29 Pin cathode Body (red) anode
AEY29R	Equivalent to AEY29 except for: reverse polarity		Pin anode Body (green) cathode
AEY31 germanium backward diode low level detector at X-band	$I_R = 100\ \mu A$ at $V_R = 0{,}3$ V $I_F = 12$ mA at $V_F = 0{,}3$ V tangential sensitivity = -53 dBm $Z_{iv} = 300\ \Omega$	$T_{stg} = +100°C$ $T_{amb} = 100°C$	 AEY31 cathode marked red
AEY31A	Equivalent to AEY31 except for: Tangential sensitivity = -50 dBm		

BAV46
silicon
detector
diode
doppler radar

Current sensitivity = 1,0 μA
tangential sensitivty = 52 dBm
F = 10 dB
Z_{io} = 850 Ω

R.F. spike = 0,2 erg
P_{tot} (peak) = 1,0 W
T_{stg} = +150 °C
T_{amb} = 150 °C

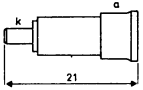


BAV46

BAW95D
silicon
mixer diode
up to 18 GHz

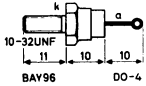
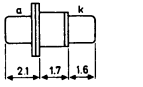
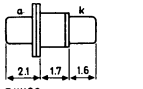
F < 8,2 dB
Z_{if} > 250 Ω and < 500 Ω

R.F. spike = 0,2 erg
P_{tot} = 1,0 W

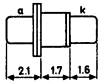
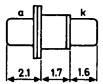
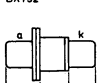
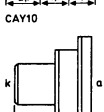
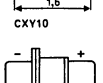


BAW95D

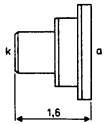
BAW95E Equivalent to BAW95D except for: F < 7,5 dB
BAW95F Equivalent to BAW95E except for: F < 7,0 dB
BAW95G Equivalent to BAW95F except for: F < 6,5 dB

Type and applications	*Ratings* (*mA*) (*V*) (*W*) (°*C*)	R_{th} (°C/W)	I_F at V_R (μA) (*V*)	*Characteristics*	*Outlines* (*mm*)
BAY96 varactor silicon planar epitaxial	V_R = 120 P_{tot} = 20 T_j = 175 T_{stg} = +175	$R_{th\,j-mb}$ = 7,5	–	C_d = 28 to 39 pF at V_R = 6 V; f = 1 MHz r_D < 1,2 Ω at V_R = 6 V; f = 400 MHz	 BAY96 DO-4
BXY27 varactor silicon planar epitaxial	V_R = 55 P_{tot} = 4 T_j = 175 T_{stg} = +175	$R_{th\,j-pin}$ 20	T_{amb} = 25 °C < 1 6	C_d = 3.0 to 6,5 pF at V_R = 6 V; f = 1 MHz r_d = 0,4 Ω at V_R = 6 V f = 2 GHz	 BXY27
BXY28 varactor silicon planar epitaxial	V_R = 45 P_{tot} = 3,5 T_j = 175 T_{stg} = +175	$R_{th\,j-pin}$ = 30	T_{amb} = 25 °C < 1 6	C_d = 1,0 to 2,5 pF at V_R = 6 V; f = 1 MHz r_d = 0,9 Ω at V_R = 6 V f = 2 GHz	 BXY28

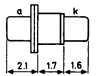
MICROWAVE DEVICES

Type and applications	*Ratings* (*mA*) (*V*) (*W*) (°*C*)	R_{th} (°*C*/*W*)	I_R at V_R (μA) (*V*)	*Characteristics*	*Outlines* (*mm*)
BXY29 varactor silicon planar epitaxial	V_R = 25 P_{tot} = 1 T_j = 150 T_{stg} = +150	$R_{th\,j-pin}$ = 50	T_{amb} = 25°C < 1 6	C_d = 0,8 to 1,5 pF at V_R = 6 V; f = 1 MHz L_d = 650 pH	 BXY29
BXY32 varactor planar epitaxial	V_R = 20 P_{tot} = 1 T_j = 150 T_{stg} = +150	$R_{th\,j-pin}$ = 50	T_{amb} = 25°C < 1 6	C_d = 0,5 to 1 pF at V_R = 6 V; f = 1 MHz L_d = 650 pH	 BXY32
CAY10 varactor gallium arsenide	V_R = 6 $I_{F(AV)}$ = 70 P_{tot} = 0,05 T_j = 150 T_{stg} = +150	$R_{th\,j-pin}$ = 900	T_{amb} = 25°C < 1 6	C_m = 0,3 to 0,5 pF at V_R = 0 f_C > 125 GHz; V_R = 0 f_C = 150 GHz; V_R = 6 f_{res} = 10 GHz at V_R = 0	 CAY10
CXY10 varactor gallium arsenide diffused mesa	V_R = 6 P_{tot} = 0,05 T_j = 135 T_{stg} = +175	$R_{th\,j-mb}$ 900	T_{amb} = 25°C < 1 6	C_d = 0,2 pF at V_R = 0 r_d = 2,25 Ω at V_R = 0 L_s = 140 pH f_C = 350 GHz at V_R = 0 f_{res} = 30 GHz at V_R = 0	 CXY10
CXY11A gum effect diode gallium arsenide c.w. oscillations up to X-band	V = 7,0 P_{tot} = 1,0 (T_{pin} = 35°C) T_{stg} = +175°C			T_{pin} = 35°C I = 140 mA at V = 7 V f = 8 to 12 GHz P_o = 8 mW	 CXY11A

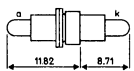
CXY11B	Equivalent to CXY11A except for: $P_o = 12$ mW			
CXY11C	Equivalent to CXY11A except for: $P_o = 20$ mW			
CXY12 varactor gallium arsenide diffused mesa	$V_R = 10$ V $P_{tot} = 0{,}3$ $P_l = 0{,}5$ $T_j = 175$ $T_{stg} = +175$	$R_{th\,j-mb} = T_{amb} = 25°C$ 500	<1 6	$C_d = 0{,}25$ pF at $V_R = 6$ V $r_d = 1{,}3\ \Omega$ $L_s = 120$ pH $f_C = 500$ GHz at $V_R = 6$ V $f_{res} = 29$ GHz at $V_R = 6$ V
1N5152 varactor silicon planar epitaxial S-band	$V_R = 75$ $P_{tot} = 5$ $T_j = 175$ $T_{stg} = +175$	$R_{th\,j-pin} =$ $T_{amb} = 25°C$ 20	<1 60	$C_d = 5{,}0$ to $7{,}5$ pF at $V_R = 6$ V; $f = 1$ MHz $f_C = 100$ GHz at $V_R = 6$ V; $f = 2$ GHz
1N5153	Equivalent to 1N5152 except for outline			
1N5155 varactor silicon planar epitaxial freq. multipliers up to C-band	$V_R = 35$ $P_{tot} = 3$ $T_j = 175$ $T_{stg} = +175$	$R_{th\,j-pin} =$ 35	<1 26	$C_d = 1{,}0$ to $3{,}0$ pF at $V_R = 6$ V; $f = 1$ MHz $f_C = 120$ GHz at $V_R = 6$ V; $f = 2$ GHz
1N5157 varactor silicon planar epitaxial freq. multipliers up to X-band	$V_R = 20$ $P_{tot} = 2{,}5$ $T_j = 175$ $T_{stg} = +175$	$R_{th\,j-pin} =$ 38,5	<0,1 16	$C_d = 0{,}6$ to $1{,}0$ pF at $V_R = 6$ V; $f = 1$ MHz $f_C = 200$ GHz at $V_R = 6$ V; $f = 8$ GHz



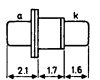
CXY12



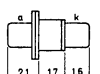
1N5152



1N5153



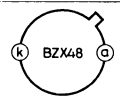
1N5155



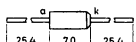
1N5157

VOLTAGE REGULATOR AND REFERENCE DIODES

Type and applications	*Ratings* (*mA*)	(*W*)	(°C)	R_{th} (°C/W)	V_F at I_F (*V*)	(*mA*)	V_Z, (*V*)	S_Z, (*mV*/°C)	r_Z at I_Z (Ω)	(*mA*)	*Outlines* (*mm*)
BZX48 5%	I_Z = 10		T_{amb} = +100	—	—	—	6.42	< +0.13	70	1	
	I_{ZM} = 10		T_{stg} = +150				6.45	< +0.13	20	2	
							6.47	< +0.13	14	3	
BZX49 5%	Equivalent to BZX48 except for							< +0.325		1 to 3	
BZX50 5%	Equivalent to BZX48 except for							< +0.65		1 to 3	



Type and applications													*Outlines* (*mm*)
BZX61-	**C7V5**	**C8V2**	**C9V1**	**C10**	**C11**	**C12**	**C13**	**C15**	**C16**	**C18**	**C20**	**C22**	**C24**	
at I_Z (*mA*)	20	20	20	20	20	20	20	20	10	10	10	10	10	
V_Z(*V*)	7.5	8.2	9.1	10	11	12	13	15	16	18	20	22	24	
S_Z(*mV*/°C)	+3.0	+3.3	+4.6	+5.0	+5.5	+6.0	+6.5	+9.0	+10	+11	+12	+13	+14	
r_Z (Ω)	<6.0	<7.5	<8.0	<8.5	<9.0	<9.0	<10	<14	<16	<20	<22	<23	<25	
BZX61-	**C27**	**C30**	**C33**	**C36**	**C39**	**C43**	**C47**	**C51**	**C56**	**C62**	**C68**	**C75**		
at I_Z (*mA*)	10	10	10	10	5	5	5	5	5	5	5	5		
V_Z(*V*)	27	30	33	36	39	43	47	51	56	62	68	75		
S_Z(*mV*/°C)	+16	+21	+23	+25	+27	+30	+38	+41	+45	+50	+54	+60		
r_Z (Ω)	<35	<40	<45	<50	<60	<70	<80	<95	<105	<110	<120	<135		
Ratings	I_{FAV} = 1 A; I_{ZM} = 3 A; P_{tot} = 1,3 W; T_j = 175°C; T_{stg} = +175°C													
Characteristics	$R_{th\,j-a}$ = 0.15°C/mW; V_F < 1.1 V at I_F = 100 mA; tolerance: 5%													



BZX70-	C10	C11	C12	C13	C15	C16	C18	C20	C22	C24	C27
at I_Z (*mA*)	50	50	50	50	50	20	20	20	20	20	20
V_Z(*V*)	10	11	12	13	15	16	18	20	22	24	27
S_Z(*mV*/°*C*)	+7.0	+7.5	+8.0	+8.5	+10	+11	+12	+14	+16	+18	+20
r_Z (Ω)	<4.0	<4.5	<5.0	<6.0	<8.0	<9	<11	<12	<13	<14	<18

BZX70-	C30	C33	C36	C39	C43	C47	C51	C56	C62	C68	C75
at I_Z (*mA*)	20	20	20	10	10	10	10	10	10	10	10
V_Z(*V*)	30	33	36	39	43	47	51	56	62	68	75
S_Z(*mV*/°*C*)	+25	+30	+32	+35	+40	+45	+50	+55	+60	+65	+70
r_Z (Ω)	<22	<25	<30	<35	<40	<50	<55	<63	<75	<90	<100

Ratings $I_{FAV} = 1$ A; $I_{FRM} = 3$ A; $I_{ZRM} = 5$ A; $P_{tot} = 2.5$ W; $T_j = 150$°C; $T_{stg} = +150$°C

Characteristics $R_{th\,j-a} = 50$°C/W; $V_F < 1.5$ V at $I_F = 1$ A; tolerance of V_Z: 5%

BZX70 series

BZX75-	C1V4	C2V	C2V8	C3V6	C1V4	C2V1	C2V8	C3V6
at I_F (mA)	1	1	1	1	10	10	10	10
V_F(V)	<1.34	<2.05	<2.70	<3.45	1.4	2.1	2.8	3.6
S_F(mV/°C)	−4	−6	−8	−10	−3.3	−5.0	−6.6	−8.2
r_d (Ω)	60	90	120	150	6	9	12	15

Ratings $I_{FRM} = 250$ mA; $V_R = 10$ V; $P_{tot} = 400$ mW; $T_j = 200$°C; $T_{stg} = +175$°C

Characteristics $R_{th\,j-a} = 0{,}4$°C/mW; $I_R < 500$ nA (C1V4, C2V1) < 200 nA (C2V8, C3V6) at $V_R = 5$ V

$Q_s > 600$ pC at $I_F = 10$ mA to $V_R = 5$ V; $C_d < 250$ pF at $V_R = 0$; $f = 1$ MHz; tolerance of V_F: 5%

BZX75 DO-7

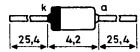
VOLTAGE REGULATOR AND REFERENCE DIODES

Type and applications — *Outlines (mm)*

BZX79-	**C4V7**	**C5V1**	**C5V6**	**C6V2**	**C6V8**	**C7V5**	**C8V2**	**C9V1**	**C10**	**C11**	**C12**	**C13**	**C15**	**C16**	**C18**
at I_Z (mA)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
V_Z(V)	4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1	10	11	12	13	15	16	18
S_Z(mV/°C)	−1.4	−0.8	+1.2	+2.3	+3.0	+4.0	+5.0	+6.0	+7.0	+8.0	+9.0	+10.5	+12.5	+13.0	+15.0
r_Z (Ω)	80	60	40	10	15	15	15	15	20	20	25	30	30	40	45
C_d(pF)*)	130	110	95	90	85	80	75	70	70	65	65	60	55	52	47

BZX79-	**C20**	**C22**	**C24**	**C27**	**C30**	**C33**	**C36**	**C39**	**C43**	**C47**	**C51**	**C56**	**C62**	**C68**	**C75**
at I_Z (mA)	5	5	5	2	2	2	2	2	2	2	2	2	2	2	2
V_Z(V)	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75
S_Z(mV/°C)	+17.0	+19.0	+21.0	+23.5	+26	+29	+31	+34	+37	+40	+44	+47	+51	+56	+60
r_Z (Ω)	55	55	70	80	80	80	90	130	150	170	180	200	215	240	255
C_d(pF)*)	36	34	33	30	27	25	23	21	21	19	19	18	17	17	16.5

*) at $V_R = 0$

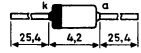


BZX79 series DO-35

Ratings $I_{F(AV)} = 250$ mA; $I_{FRM} = 250$ mA; $P_{tot} = 0.4$ W; $T_j = 200$°C; $T_{stg} = +200$°C

Characteristics $R_{th\,j-a} = 0.38$°C/mW; $V_F < 0.9$ at $I_F = 10$ mA; tolerance of V_Z: 5%

Type and applications	*Ratings* (mA)	(W)	(°C)	R_{th} (°C/mW)	V_F at I_F (V)	(mA)	V_Z, (V)	S_Z, (%/°C)	r_Z at I_Z (Ω)	(mA)	*Outlines (mm)*
BZX90	$I_Z = 50$		$T_{amb} = +100$	3,8			52	0,01	15	7,5	
BZX91	$I_{ZM} = 50$		$T_{stg} = +200$				26	0,005	15	7,5	
BZX92							10,4	0,002	15	7,5	
BZX93							5,2	0,001	15	7,5	



BZX90 to 93 DO-35

BZY78 1%	$I_{FAV}=50$ $I_{FRM}=50$ $I_Z=25$ $I_{ZRM}=25$	$P_{tot}=0.28$ $T_j=150$ $T_{stg}=+150$	$R_{th\,j-a}=$ 450	<0.75	1	5.3	18	11.5	$T_j=-40$ to $+25°C$: $S_Z=+0.32$ mV/°C $T_j=+25$ to $+100°C$: $S_Z=-0.21$ mV/°C

BZY78 DO-7

Type and applications	*Outlines (mm)*

BZY88-	**C3V3**	**C3V6**	**C3V9**	**C4V3**	**C4V7**	**C5V1**	**C5V6**	**C6V2**	**C6V8**	**C7V5**	**C8V2**	**C9V1**
at I_Z *(mA)*	5	5	5	5	5	5	5	5	5	5	5	5
V_Z *(V)*	3.3	3.6	3.9	4.3	4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1
S_Z *(mV/°C)*	−2.3	−2.0	−2.05	−1.8	−1.55	−1.2	−0.2	+2.0	+3.2	+4.2	+5.0	+6.0
r_Z (Ω)	83.5	76	76	70	62	46	22	7.0	3.0	3.0	3.5	4.75

BZY88series DO-7

BZY88-	**C10**	**C11**	**C12**	**C13**	**C15**	**C16**	**C18**	**C20**	**C22**	**C24**	**C27**	**C30**
at I_Z *(mA)*	5	5	5	5	5	5	5	5	5	5	5	5
V_Z *(V)*	10	11	12	13	15	16	18	20	22	24	27	30
S_Z *(mV/°C)*	+7.0	+8.7	+9.0	+10.5	+12.5	+13	+15	+17	+19	+21	+23.5	+26
r_Z (Ω)	5.0	7.0	8.0	10	15	20	25	30	35	40	50	60

Ratings $I_{FRM}=250$ mA/ $I_{ZRM}=250$ mA; $P_{tot}=0.4$ W; $P_{ZSM}=15$ W; $T_j=175°C$; $T_{stg}=+175°C$

Characteristics $R_{th\,j-a}=310°C/W$; $V_F<0.9$ V at $I_F=10$ mA; tolerance of V_Z: 5%

VOLTAGE REGULATOR AND REFERENCE DIODES

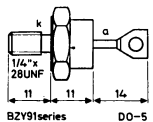
Type and applications — *Outlines (mm)*

BZY91-	**C10**	**C11**	**C12**	**C13**	**C15**	**C16**	**C18**	**C20**	**C22**	**C24**	**C27**	**C30**	**C33**	**C36**
at I_Z *(A)*	2	2	2	2	2	2	2	1	1	1	1	1	1	1
V_Z *(V)*	10	11	12	13	15	16	18	20	22	24	27	30	33	36
S_Z *(mV/°C)*	9	10	11	12	13	15	16	15	17	19	22	25	28	32
r_Z (Ω)	<0.4	<0.4	<0.5	<0.5	<0.6	<0.6	<0.7	<0.8	<0.8	<0.9	<1.0	<1.1	<1.2	<1.3

BZY91-	**C39**	**C43**	**C47**	**C51**	**C56**	**C62**	**C68**	**C75**
at I_Z *(A)*	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
V_Z *(V)*	39	43	47	51	56	62	68	75
S_Z *(mV/°C)*	35	39	44	48	53	59	64	71
r_Z (Ω)	<1.4	<1.5	<1.7	<1.8	<2.0	<2.2	<2.4	<2.6

Ratings $I_{FAV} = 10$ A; $I_{FRM} = 30$ A; $I_{ZRM} = 100$ A; $P_{tot} = 75$ W; $T_j = 175$°C; $T_{stg} = +175$°C
$P_{ZSM} = 4400$ W (0.1 ms); 1480 W (1 ms); 500 W (10 ms); 170 W (100 ms)

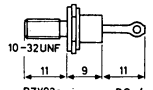
Characteristics $R_{th\,j-mb} = 1.47$°C/W; $V_F < 1.5$ V at $I_F = 10$ A; tolerance of V_Z: 5%
Reverse polarity types available



BZY93-		**C7V5**	**C8V2**	**C9V1**	**C10**	**C11**	**C12**	**C13**	**C15**	**C16**	**C18**	**C20**	**C22**
at I_Z *(A)*		2	2	1	1	1	1	1	1	0.5	0.5	0.5	0.5
V_Z *(V)*		7.5	8.2	9.1	10	11	12	13	15	16	18	20	22
S_Z *(mV/°C)*		3	4	5	7	7.5	8	8.5	10	11	12	14	16
r_Z (Ω)		0.04	0.05	0.07	0.07	0.08	0.08	0.08	0.1	0.18	0.2	0.2	0.21
BZY93-	**C24**	**C27**	**C30**	**C33**	**C36**	**C39**	**C43**	**C47**	**C51**	**C56**	**C62**	**C68**	**C75**
at I_Z *(A)*	0.5	0.5	0.5	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
V_Z *(V)*	24	27	30	33	36	39	43	47	51	56	62	68	75
S_Z *(mV/°C)*	18	21	25	30	32	35	40	45	50	55	60	65	70
r_Z	0.22	0.25	0.3	0.32	0.75	0.85	0.9	1.0	1.2	1.3	1.5	1.8	2.0

Ratings $I_{FAV} = 5$ A; $I_{FRM} = 15$ A; $I_{ZRM} = 20$ A; $P_{tot} = 20$ W; $T_j = 175$°C; $T_{stg} = +175$°C

Characteristics $R_{th\,j-mb} = 5$°C/W; $V_F < 1.5$ V at $I_F = 5$ A; tolerance of V_Z: 5%

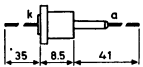


BZY95-	C10	C11	C12	C13	C15	C16	C18	C20	C22	C24	C27	C30	C33	C36
at I_Z (mA)	50	50	50	50	50	20	20	20	20	20	20	20	20	20
V_Z (V)	10	11	12	13	15	16	18	20	22	24	27	30	33	36
S_Z (mV/°C)	7	7.5	8	8.5	10	11	12	14	16	18	20	25	30	32
r_Z (Ω)	0.75	0.80	0.85	0.90	1.0	2.4	2.5	2.8	3.0	3.4	3.8	4.5	5.0	5.5

BZY95-	C39	C43	C47	C51	C56	C62	C68	C75
at I_Z (mA)	10	10	10	10	10	10	10	10
V_Z (V)	39	43	47	51	56	62	68	75
S_Z (mV/°C)	35	40	45	50	55	60	65	70
r_Z (Ω)	12	13	14	15	17	18	18	20

Ratings $I_{FAV} = 1$ A; $I_{FRM} = 3$ A; $I_{ZRM} = 5$ A; $P_{tot} = 1.5$ W; $P_{ZSM} = 100$ W; $T_j = 175$°C; $T_{stg} = +175$°C

Characteristics $R_{th\,j-a} = 100$°C/W; $V_F < 1.5$ V at $I_F = 1$ A; tolerance of V_Z: 5%

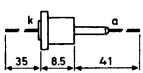


BZY95series DO-1

BZY96-	C4V7	C5V1	C5V6	C6V2	C6V8	C7V5	C8V2	C9V1
at I_Z (mA)	100	100	100	100	100	50	50	50
V_Z (V)	4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1
S_Z (mV/°C)	−0.6	+0.1	+1	+2	+3	+4	+5	+6.4
r_Z (Ω)	2.5	1.0	0.7	0.6	0.6	1.0	1.2	1.8

Ratings $I_{FAV} = 1$ A; $I_{FRM} = 3$ A; $I_{ZRM} = 3.5$ A; $P_{tot} = 1.5$ W; $P_{ZSM} = 20$ W; $T_j = 175$°C; $T_{stg} = +175$°C

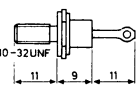
Characteristics $R_{th\,j-a} = 100$°C/W; $V_F < 1.5$ V at $I_F = 1$ A; tolerance of V_Z: 5%



BZY96series DO-1

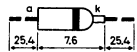
VOLTAGE REGULATOR AND REFERENCE DIODES

Type and applications	*Ratings* (*mA*)	(*W*)	(°*C*)	R_{th} (°*C*/*W*)	V_F at I_F (*V*)	(*mA*)	V_Z, (*V*)	S_Z, (*mV*/°*C*)	r_Z at I_Z (Ω)	(*mA*)	*Outlines* (*mm*)
BZZ14 5%							5.6	+0.7	4.5	20	
BZZ15 5%							6.2	+2.1	2.2	20	
BZZ16 5%							6.8	+2.9	2.07	20	
BZZ17 5%							7.5	+3.75	2.3	20	
BZZ18 5%							8.2	+4.7	2.6	20	
BZZ19 5%	I_{FAV} = 500						9.1	+5.8	3.18	20	
BZZ20 5%	I_{FRM} = 7000			$R_{th\,j-a}$ = 70			10	+7.0	3.8	20	
BZZ21 5%	I_{ZRM} = 7000				<1.0	200	11	+7.5	4.4	20	
BZZ22 5%	P_{tot} = 10						12	+8.8	5.25	20	
BZZ23 5%	P_{ZSM} = 45			$R_{th\,j-mb}$ = 10			13	+10.0	6.3	20	
BZZ24 5%	T_j = 150						15	+12.6	8.9	20	
BZZ25 5%	T_{stg} = +150						16	+13.8	10.5	20	
BZZ26 5%							18	+16.4	14.5	20	
BZZ27 5%							20	+19.0	19.5	20	
BZZ28 5%							22	+21.6	26	20	
BZZ29 5%							24	+24.2	33.5	20	



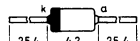
BZZ14 to 29 DO-4

1N748A	5%				3.9	−1.90	<23	20
1N749A	5%				4.3	−1.55	<22	20
1N750A	5%				4.7	−0.845	<19	20
1N751A	5%	I_{FAV} = 250			5.1	−0.405	<17	20
1N752A	5%	I_{ZRM} = 250			5.6	+0.336	<11	20
1N753A	5%	P_{tot} = 0.4	$R_{th\,j-a}$ = 310	<0.9 10	6.2	+1.36	<7	20
1N754A	5%	T_j = 175			6.8	+2.38	<5	20
1N755A	5%	T_{stg} = +175			7.5	+3.37	<6	20
1N756A	5%				8.2	+4.26	<8	20
1N757A	5%				9.1	+5.1	<10	20
1N758A	5%				10	+6.0	<17	20
1N759A	5%				12	+7.2	<30	20



1N746A to 1N759A DO-7

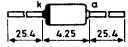
Type and applications	*Ratings* (mA)	(mW)	(°C)	$R_{th\,j-a}$ (°C/mW)	*Characteristics at* I_Z = 7,5 mA; T_j = 25°C V_{REF} (V)	ΔV_{REF} (mV)	S_Z (%/°C)	r_Z (Ω)	*Outlines* (mm)
1N821	I_{ZM} = 50				6,2	96	±0,01	15	
1A823	P_{tot} = 400				6,2	48	±0,005	15	
1A825	T_{amb} = +100			0,375	6,2	19	±0,002	15	
1A827	T_{stg} = +200				6,2	9	±0,001	15	
1A829					6,2	5	±0,0005	15	



1N821 to 1N829 DO-35

VOLTAGE REGULATOR AND REFERENCE DIODES

Type and applications	Ratings I_Z (mA)	I_{ZSM} (A)	R_{th} (°C/W)	V_F at I_F (V)	(I_F mA)	V_Z; S_Z at I_Z (V_Z V)	(S_Z mV/°C)	I_Z (mA)	z_z (Ω)	Outlines (mm)
1N5729B 5%	65	2.90				5.1	−0.2	10	50	
1N5730B 5%	60	2.60				5.6	+1.2	10	25	
1N5631B 5%	55	2.40				6.2	+2.3	10	10	
1N5732B 5%	50	2.30				6.8	+3.0	10	10	
1N5733B 5%	45	2.10				7.5	+4.0	10	10	
1N5734B 5%	40	1.95				8.2	+5.0	10	15	
1N5735B 5%	40	1.80				9.1	+6.0	10	15	
1N5736B 5%	35	1.65				10.0	+7.0	10	20	
1N5737B 5%	30	1.50				11.0	+8.0	5	20	
1N5738B 5%	30	1.40				12.0	+9.0	5	25	
1N5739B 5%	25	1.28				13.0	+10.5	5	30	
1N5740B 5%	25	1.20				15.0	+12.5	5	30	
1N5741B 5%	20	1.13	P_{tot} = 400 mW			16.0	+13.0	5	40	
1N5742B 5%	20	1.05	P_{ZSM} = 30 W $R_{th\,j-a}$ = 380	<0.9	10	18.0	+15.0	5	45	
1N5743B 5%	15	0.98	T_j = 200°C			20.0	+17.0	5	55	
1N5744B 5%	15	0.90	T_{stg} = +200°C			22.0	+19.0	5	55	
1N5745B 5%	15	0.83				24.0	+21.0	5	70	
1N5746B 5%	10	0.75				27.0	+23.5	2	80	
1N5747B 5%	10	0.68				30.0	+26.0	2	80	
1N5748B 5%	10	0.64				33.0	+29.0	2	90	
1N5749B 5%	10	0.60				36.0	+31.0	2	90	
1N5750B 5%	9	0.57				39.0	+34.0	2	130	
1N5751B 5%	9	0.53				43.0	+37.0	2	150	
1N5752B 5%	8	0.49				47.0	+40.0	2	170	
1N5753B 5%	7	0.45				51.0	+44.0	2	180	
1N5754B 5%	6	0.42				56.0	+47.0	2	200	
1N5755B 5%	6	0.38				62.0	+51.0	2	215	
1N5756B 5%	5	0.34				68.0	+56.0	2	240	
1N5757B 5%	5	0.30				75.0	+60.0	2	255	



1N5729B to 1N5757B

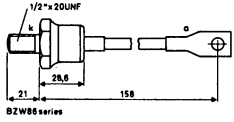
TRANSIENT SUPPRESSOR DIODES

Type and applications

Outlines (mm)

BZW86-	**7V5**	**8V2**	**9V1**	**10**	**11**	**12**	**13**	**15**	**16**	**18**	**20**	**22**
at I_R (kA)	1	1	1	1	1	1	1	1	0,5	0,5	0,5	0,5
$V_{(CL)R}$ (V)	12	13	14	15,5	17	18,5	20	23	27	31	34	37
at I_R (A)	10	10	10	10	10	10	10	10	5	5	5	5
$V_{(BR)R}$ (V)	8,5	9,4	10,4	11,4	12,4	13,8	15,3	16,8	18,8	20,8	22,8	25,1

BZW86-	**24**	**27**	**30**	**33**	**36**	**39**	**43**	**47**	**51**	**56**	**62**
at I_R (kA)	0,5	0,5	0,5	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
$V_{(CL)R}$ (V)	40	44	47	51	55	60	66	72	78	85	92
at I_R (A)	5	5	5	2	2	2	2	2	2	2	2
$V_{(BR)R}$	28	31	34	37	40	44	48	52	58	64	70



Ratings

BZW86-9V1: $I_{RSM} = 3700$ A
BZW86-27: $I_{RSM} = 1200$ A
BZW86-56: $I_{RSM} = 700$ A
BZW86-62: $I_{RSM} = 700$ A
} at $t_p = 10\ \mu s$ square pulse

$P_{RRM} = 50$ kW
$P_{RSM} = 60$ kW
$T_j = 175°C$
$T_{stg} = -55$ to $+175°C$

$R_{th\,j-mb} = 0{,}3°C/W$; $R_{th\,mb-h} = 0{,}1°C/W$

Characteristics

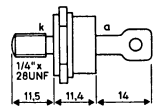
$V_F < 1{,}5$ V at $I_F = 500$ A ; $S = +0{,}1\,\%/°C$
Reverse polarity types available

Type and applications

Outlines (mm)

BZW91-	**5V6**	**-6V2**	**6V8**	**7V5**	**8V2**	**9V1**	**10**	**11**	**12**	**13**	**15**	**16**	**18**
at I_R (A)	150	150	150	150	150	150	150	150	150	150	100	100	100
$V_{(CL)R}$ (V)	8,5	9,5	10	11	12	13	14,5	16	17,5	19	22	24	26
at I_R (A)	5	5	5	2	2	2	2	2	2	2	2	1	1
$V_{(BR)R}$ (V)	6,4	7,0	7,7	8,5	9,4	10,4	11,4	12,4	13,8	15,3	16,8	18,8	20,8

BZW91-	**20**	**22**	**24**	**27**	**30**	**33**	**36**	**39**	**43**	**47**	**51**	**56**	**62**
at I_R (A)	100	100	100	100	50	50	50	50	50	50	50	50	50
$V_{(CL)R}$ (V)	28	31	34	38	40	44	49	54	60	66	72	79	86
at I_R (A)	1	1	1	1	1	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
$V_{(BR)R}$ (V)	22,8	25,1	28	31	34	37	40	44	48	52	58	64	70



BZW91 series

Ratings

BZW91-6V8: $I_{RSM} = 2800$ A
BZW91-11: $I_{RSM} = 1700$ A
BZW91-18: $I_{RSM} = 1000$ A
BZW91-39: $I_{RSM} = 480$ A
BZW91-62: $I_{RSM} = 350$ A

at $t_p = 10\ \mu s$ square pulse

$P_{RRM} = 25$ kW
$P_{RSM} = 27$ kW
$T_j = 175°C$
$T_{stg} = -55$ to $+175°C$

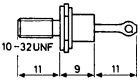
$R_{th\,j-a} = 25°C/W$; $R_{th\,j-mb} = 1{,}5°C/W$; $R_{th\,mb-h} = 0{,}2°C/W$

Characteristics

$V_F < 1{,}5$ V at $I_F = 10$ A; $S = +0{,}1\ \%/°C$
Reverse polarity types available.

BZW93-	**5V6**	**6V2**	**6V8**	**7V5**	**8V2**	**9V1**	**10**	**11**	**12**	**3**	**15**	**16**	**18**
at I_R (A)	20	20	20	20	20	20	20	20	20	20	20	10	10
$V_{(CL)R}$ (V)	9	10	11	12	13,5	15	17	19	21	23	22	25	28
at I_R (A)	2	2	2	1	1	1	1	1	1	0,5	0,5	0,5	0,5
$V_{(BR)R}$ (V)	6,4	7,0	7,7	8,5	9,4	10,4	11,4	12,4	13,8	15,3	16,8	18,8	20,8

BZW93-	**20**	**22**	**24**	**27**	**30**	**33**	**36**	**39**	**43**	**47**	**51**	**56**	**62**
at I_R (A)	10	10	10	10	5	5	5	5	5	5	5	5	5
$V_{(CL)R}$ (V)	32	36	41	47	44	49	56	63	71	80	89	98	104
at I_R (A)	0,5	0,5	0,5	0,5	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2



Ratings

BZW93-6V8: $I_{RSM} = 300$ A
BZW93-11: $I_{RSM} = 180$ A
BZW93-18: $I_{RSM} = 100$ A
BZW93-39: $I_{RSM} = 50$ A
BZW93-62: $I_{RSM} = 33$A
} at $t_p = 10\ \mu s$ square pulse

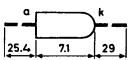
$P_{RRM} = 3$ kW
$P_{RSM} = 3$ kW
$T_j = 175°C$
$T_{stg} = -55$ to $+175°C$

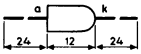
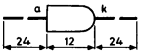
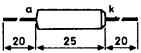
$R_{th\,j-a} = 50°C/W$; $R_{th\,j-mb} = 5{,}0°C/W$; $R_{th\,mb-h} = 0{,}6\ °C/W$

Characteristics

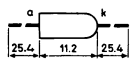
$V_F < 1{,}5$ V at $I_F = 10$ A; $S = +0{,}1\ \%/°C$
Reverse polarity types available.

RECTIFIER DIODES

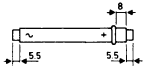
Type and applications	Ratings (mA)	(V)	(°C)	$R_{th\,j-a}$ (°C/mW)	V_F at I_F (V)	(mA)	I_R at V_R (μA)	(V)	Char.	Outlines (mm)
BA145 clamping diode silicon double diffused	I_F = 300 I_{FRM} = 2000 V_{RWM} = 300 V_{RRM} = 350	T_j =	125 T_{stg} = +125	0.2	T_j = 125°C 0.3 0.4 0.56 1.0	1 10 100 2000	T_j = 125°C 10 25 52	10 100 300	C_d = 4 pF Q_s < 0.4 nC	BA145 DO-14
BA148 clamping diode silicon double diffused	I_{FAV} = 400 I_{FRM} = 3000 V_{RWM} = 300 V_{RRM} = 350	T_j =	150 T_{stg} = +125	0.2	T_j = 150°C <0.6 <1 <1.5	25 200 2000	T_j = 125°C 10 25 52	10 100 300	C_d = 4 pF Q_s < 0.8 nC	 BA148 DO-14

Type and applications	Ratings I_{FAV} (A)	I_{FRM} (A)	I_{FSM} (A)	V_{RWM} (V)	V_{RRM} (V)	V_{RSM} (V)	*$R_{th\,j-a}$ $R_{th\,j-mb}$ (°C/W)	Outlines (mm)
BY126 mains rectifier	1.2	10	40	450	650	650	*60	 BY126
BY127 mains rectifier	1.2	10	40	800	1250	1250	*60	 BY127
BY164	See section Rectifier Stacks							
BY176 e.h.t. rectifier	2.5 (mA)	0.25 I_{RRM} = 0.15	—	15 (kV)	15 (kV)	15 (kV)	—	 BY176

BY179		See section Rectifier stacks						
BY184 $V_{\phi 2}$ supply, colour t.v. silicon		2.0 (mA)	100 (mA)	1	1500	1800	1800	*175
BY185 horizontal deflection colour t.v.		2.5 (mA)	500 (mA)	I_{RRM} 150 (mA)	35000	35000	35000	$V_F < 120$ V at $I_F = 200$ mA $Q_s = 5$ nC at $I_F = 200$ mA
BY187 tripler focus rect. colour t.v.		2.5 (mA)	500 (mA)	I_{RRM} 150 (mA)	11500	12500	12500	$V_F < 26$ V at $I_F = 100$ mA $Q_s = 5$ nC at $I_F = 200$ mA
BYX10 low current rect.		0.5	3	15	800	1600	1600	*150
BYX13 mains rectifier	**-800(R)** **-1000(R)** **-1200(R)**	20	100	400	400 500 600	800 1000 1200	800 1000 1200	1.1
BYX22 power rectifier	**-600** **-1200**	1.4	15	40	400 800	600 1200	600 1200	*60 solder tags 10 mm

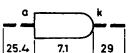


BY184

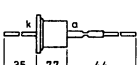


BY185

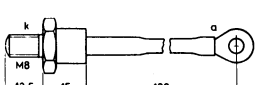
BY187



BYX10 DO-14

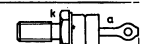
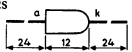


BYX22 series DO-1

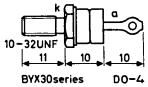


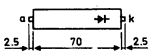
BYX13 series

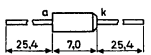
RECTIFIER DIODES

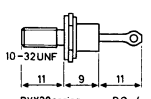
Type and applications		*Ratings* I_{FAV} (A)	I_{FRM} (A)	I_{FSM} (A)	V_{RWM} (V)	V_{RRM} (V)	V_{RSM} (V)	$*R_{th\,j-a}$ $R_{th\,j-mb}$ (°C/W)	*Outlines* (mm)
BYX25	**-600(R)**				600	P_{RAV} = 38 W		*50	
mains	**-800(R)**	20	440	360	800	P_{RRM} = 3 kW		1.3	
rectifier	**-1000(R)**				1000	P_{RSM} = 18 kW			
									BYX25series DO-4
BY188A; **BY188B** horizontal deflection		1,2	10	40	—	50	75	*60°C/W V_F < 1,5 V at I_F = 5 A BY188A: t_d > 0 μs BY188B: t_d > 0,7 μs	
									BY188series
BY206 top level detector; scan rect.; h.f. power supplies		0,4	5	15	300	350	350	*150°C/W V_F < 1,5 V at I_F = 2 A C_d = 4 pF at V_R = 150 V Q_s < 60 nC; t_{rr} < 1 μs; t_f > 0,1 μs at I_P = 400 mA	
									BY206 DO-14
								$R_{th\,j-oil}$ =	
BYX29	**-75000**				75 kV			3.2	
high volt.	**-100000**	50	0.25	5	100 kV	—	—	2.7	
in X-ray	**-125000**	(mA)			125 kV			1.6	
	-150000				150 kV			1.6	

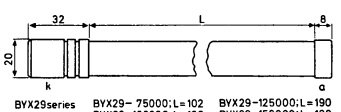
BYX30	**-200(R)**		310		200	$P_{RAV} = 30$ W		
fast	**-300(R)**				300	$P_{RRM} = 5.5$ kW		*50
switch	**-400(R)**	14	$I_{RRM} = 20$	250	400	$P_{RSM} = 18$ kW		1.3
	-500(R)				500			
	-600(R)				600			
BYX32	**-400(R)**				400	400	450	
mains	**-600(R)**				600	600	650	
rectifier	**-800(R)**	150	750	1600	800	800	900	0.4
	-1000(R)				1000	1000	1100	
	-1200(R)				1200	1200	1300	
	-1600(R)				1200	1600	1600	
BYX35		50	0.16	15	25	37.5	40	$R_{th\,j-oil} =$
high voltage		(mA)			(kV)	(kV)	(kV)	8
in X-ray, LASER								
BYX36	**-150**				100	150	150	
general	**-300**	0.8	5	30	200	300	300	
purpose	**-600**				400	600	600	
BYX38	**-300(R)**				200	300	300	
mains	**-600(R)**				400	600	600	
rectifier	**-900(R)**	6	20	38	600	900	900	
	-1200(R)				800	1200	1200	

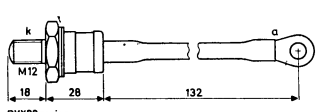






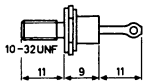




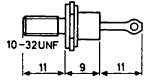


RECTIFIER DIODES

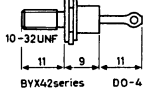
Type and applications		*Ratings* I_{FAV} (A)	I_{FRM} (A)	I_{FSM} (A)	V_{RWM} (V)	V_{RRM} (V)	V_{RSM} (V)	$*R_{th\,j-a}$ $R_{th\,j-mb}$ (°C/W)	*Outlines* (mm)
BYX39	**-600(R)**				600	P_{RAV} = 10 W		*50	
power	**-800(R)**	9,5	100	100	800	P_{RRM} = 2 kW		4.5	
rectifier	**-1000(R)**				1000	P_{RSM} = 4 kW			
BYX40	**-600(R)**				600	P_{RRM} = 1.2 kW		*50	
power	**-800(R)**	12	250	180	800	P_{RSM} = 8 kW		2.2	
rectifier	**-1000(R)**				1000				
BYX42	**-300(R)**				200	300	300		
mains	**-600(R)**	10	60	125	400	600	600	*50	
rectifier	**-900(R)**				600	900	900	3	
	-1200(R)				800	1200	1200		
BYX45	**-600R**				600	P_{RRM} = 800 W		*60	
series	**-800R**	1.5	15	40	800	P_{RSM} = 2.5 kW		solder tags	
rectifi-	**-1000R**				1000			10 mm	
cation									
BYX46	**-200(R)**				200				
fast	**-300(R)**				300	P_{RRM} = 9.5 kW		*50	
recovery	**-400(R)**	22	400	300	400	P_{RSM} = 18 kW		1.3	
rectifier	**-500(R)**				500				
	-600(R)				600				



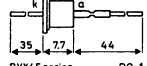
BYX39series DO-4



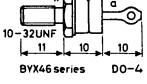
BYX40 series DO-4



BYX42series DO-4

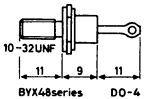


BYX45series DO-1

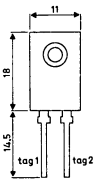


BYX46series DO-4

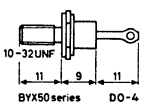
BYX48	**-300(R)**				200	300	300	
mains	**-600(R)**	6	36	90	400	600	600	*50
rectifier	**-900(R)**				600	900	900	4.5
	-1200(R)				800	1200	1200	
BYX49	**-300(R)**				200	300	300	*50°C/W
power	**-600(R)**	6	20	40	400	600	600	4,5°C/W
rectifier	**-900(R)**				600	900	900	$V_F < 2{,}3$ V
	-1200(R)				800	1200	1200	at $I_F = 20$A
BYX50	**-200(R)**				200	200	250	*50
power	**-300(R)**				300	300	350	3.5
rectifier	**-400(R)**	6	40	80	400	400	450	
	-500(R)				500	500	550	
	-600(R)				600	600	650	
BYX52	**-300(R)**				200	300	300	
power	**-600(R)**	40	450	800	400	600	600	0.8
rectifier	**-900(R)**				600	900	900	
	-1200(R)				800	1200	1200	
BYX55	**-350**	1,2	8	40	300	350	350	*60
power	**-600**				500	600	600	
rectifier								



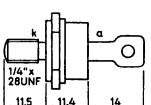
BYX48series DO-4



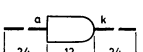
BYX49 series



BYX50series DO-4



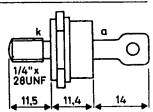
BYX52 series



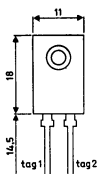
BYX55 series

RECTIFIER DIODES

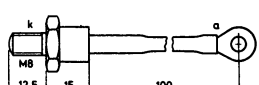
Type and applications		*Ratings* I_{FAV} (A)	I_{FRM} (A)	I_{FSM} (A)	V_{RWM} (V)	V_{RRM} (V)	V_{RSM} (V)	$^*R_{th\,j-a}$ $R_{th\,j-mb}$ (°C/W)	*Outlines* (mm)
BYX56 power rectifier	**-600(R)**	47	450	800	600	$P_{RRM}=6{,}5$ kW		0,8	
	-800(R)				800	$P_{RSM}=40$ kW			
	-1000(R)				1000				
BYX59 high freq. power rectifier	**-200**	70	1000	1200	200	200	220	0.4	
	-300				300	300	330		
	-400				400	400	440		
	-500				500	500	550		
BYX71 chopper switched-mode power supplies scan rect. efficience diode in t.v.	**-350(R)**	7	25	60	300	350	350	*50°C/W	
	-600(R)				500	600	600	6,5°C/W	
								$V_F < 1{,}25$ V at $I_F = 5$ A	
								$C_d = 8$ pF at $V_R = 250$ V	
								$Q_s < 700$ nC; $t_{rr} < 300$ ns	
								$t_f > 150$ ns at $I_F = 2$ A	



BYX56 series

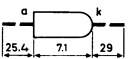


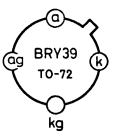
BYX71series



BYX59 series

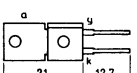
THYRISTORS

Type and applications	*Ratings* (mA)	(V)	(°C)	$R_{th\,j-a}$ (°C/mW)	V_F at I_F (V)	(mA)	I_R at V_R (μA)	(V)	*Char.*	*Outlines* (mm)
BR100 trigger device silicon	$I_{FRM}=2A$ $P_{tot}=150$ mW		$T_j=100$ $T_{stg}=+100$	0.2	$T_j=25°C$ $V_{(BO)}<36$ $I_{(BO)}<0.02$		$T_j=25°C$ $\Delta V>6$			 BR100 DO-14

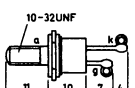
Type and applications	*Ratings:* I (A)	V_{DRM} V_{RRM} (V)	V_{DSM} V_{RSM} (V)	$*V_{RGKM}$ V_{RGAM} (V)	T_j (°C)	$*R_{th\,j-a}$ $R_{th\,j-c}$ (°C/mW)	*Characteristics* at $T_j=25°C$	*Outlines* (mm)
BRY39 p-n-p-n trigger device switching relay, lamp driver	$I_T=0.175$ $I_{TRM}=2.5$ $I_{TSM}=3$ $dI_T/dt=20$ (A/μs) $I_{FGKM}=0.1$ $I_{FGAM}=0.1$	70	70	*5 70	150	*0.45 0.15	$V_T<1.4$ V at $I_T=100$ mA $I_{RM}<100$ nA at $V_{RM}=70$ V $I_{DM}<100$ nA at $V_{DM}=70$ V $I_H<250$ μA at $R_{GK}=10$ kΩ $R_{GA}=220$ kΩ $t_{on}<300$ ns at $I_T=150$ mA $t_{off}<3$ μs at $I_T=150$ mA	

THYRISTORS

Type and applications	*Ratings:* I (A)	V_{RWM} V_{DWM} (V)	V_{DRM} (V)	V_{DSM} (V)	$*V_{FGM}$ V_{RGM} (V)	$*P_{GAV}$ P_{GM} (W)	T_j $(°C)$	$R_{th\,j-mb}$ $(°C/W)$	I_H (mA)	t_{on} (μs)	t_q (μs)
BT100A -300R	I_{TAV} = 2	200	300	300	5	*0.1	100	8	4	1.3	10
-500R	$I_{T(RMS)}$ = 4.5	400	500	500		1					
	I_{TRM} = 20										
	I_{TSM} = 40										
	I_{FGM} = 0.25										
BT101-300R	I_{TAV} = 6.5	200	300	300	*10	*0.5	125	3	—	—	—
-500R	$I_{T(RMS)}$ = 15	400	500	500	5	5					
	I_{TRM} = 50										
	I_{TSM} = 55										
	I_{FGM} = 2										
BT102	Equivalent to BT101										

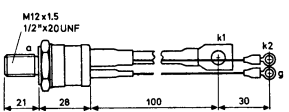


BT100A series

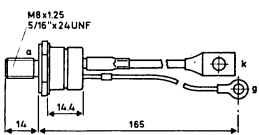


BT101

Type and application	*Ratings:* I (A) $(A/\mu s)$	V_{DSM} V_{RSM} (V)	V_{DRM} V_{RRM} (V)	V_{DWM} V_{RWM} (V)	V_{RGM} (V)	$*P_{G(AV)}$ P_{GM} (W)	T_j $(°C)$	$R_{th\,j-mb}$ $(°C/W)$	*Characteristics at $T_j = 25°C$ * $T_j = 125°C$*
BTW23 -600RM(U)	$I_{T(AV)} = 90$	700	600	600					$V_T < 2{,}2$ V at $I_T = 500$ A
-800RM(U)	$I_{T(RMS)} = 140$	900	800	800		*2			$*dV_D/dt < 200\ V/\mu s$
-1000RM(U)	$I_{TRM} = 1250$	1100	1000	1000	10	10	125	0.3	$I_H < 200$ mA
-1200RM(U)	$I_{TSM} = 2000$	1300	1200	1200					$t_{on} < 2.5\ \mu s$
-1400RM(U)	$dI_T/dt = 300$	1400	1400	1200					$t_q < 120\ \mu s$
-1600RM(U)	at $dI_G/dt = 1$	1600	1600	1200					$*t_q < 200\mu s$
BTW24- 600RM(U)	$I_{T(AV)} = 35$	700	600	600					$V_T < 1{,}9$ V at $I_T = 100$ A
- 800RM(U)	$I_{T(RMS)} = 55$	900	800	800		*1			$*dV_D/dt < 200$ V/μs
-1000RM(U)	$I_{TRM} = 450$	1100	1000	1000	10	5	125	0.6	$I_H < 200$ mA
-1200RM(U)	$I_{TSM} = 800$	1300	1200	1200					$I_L < 300$ mA
-1400RM(U)	$dI_T/dt = 300$	1400	1400	1200					$t_{on} = 2\ \mu s$
-1600RM(U)	at $dI_G/dt = 1$	1600	1600	1200					$*t_q < 100\ \mu s$
									$*t_q < 200\ \mu s$



BTW23 series-M (M12x1.5)
BTW23 series-U (1/2"x20UNF)

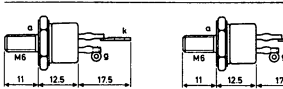


BTW24 series-M(M8x1.25)
BTW24 series-U(5/16"x24UNF)

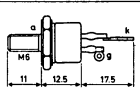
THYRISTORS

Type and application	*Ratings:* I (A) ($A/\mu s$)	V_{DSM} V_{RSM} (V)	V_{DRM} V_{RRM} (V)	V_{DWM} V_{RWM} (V)	V_{RGM} (V)	$*P_{G(AV)}$ P_{GM} (W)	T_j (°C)	$R_{th\,j-mb}$ (°C/W)	*Characteristics at $T_j = 25°C$* *$T_j = 125°C$*
BTW30 - 300RM	$I_{T(AV)} = 16$	300	300	300					$V_T < 5$ at $I_T = 50$ A
- 400RM	$I_{T(RMS)} = 25$	400	400	400					*$dV_D/dt < 200$ V/μs
- 500RM	$I_{TRM} = 150$	500	500	500		*1			$I_H < 200$ mA
- 600RM	$I_{TSM} = 150$	600	600	600	10	5	125	1.0	$t_{on} < 2$ μs
- 800RM	$dI_T/dt = 100$	800	800	600					*t_q: 6 to 12 μs
-1000RM	at $dI_G/dt = 1$	1000	1000	700					
-1200RM		1200	1200	800					
BTW31 -300RM	$I_{T(AV)} = 22$	300	300	300					$V_T < 2.9$ V at $I_T = 50$ A
-400RM	$I_{T(RMS)} = 31$	400	400	400					*$dV_D/dt < 200$ V/μs
-500RM	$I_{TRM} = 150$	500	500	500		*1			$I_H < 200$ mA
-600RM	$I_{TSM} = 225$	600	600	600	10	5	125	1.0	$t_{on} < 2$ μs
-800RM	$dI_T/dt = 100$	800	800	600					*t_q: 12 to 20 μs
-1000RM	at $dI_G/dt = 1$	1000	1000	700					
-1200RM		1200	1200	800					
BTW32 -600RM	$I_{T(AV)} = 37$	600	600	500					$V_T < 3,5$ V at $I_T = 100$A
-800RM	$I_{T(RMS)} = 55$	800	800	600		*1			$dV_D/dt < 200$ V/μs
-1000RM	$I_{TRM} = 300$	1000	1000	800	10	5	125	0.6	$I_H < 200$ mA
-1200RM	$I_{TSM} = 600$	1200	1200	1000					$t_{on} < 2$ μs
	$dI_T/dt = 20$								$t_q < 11$ μs
	at $dT_G/dt = 1$								*$t_q < 25$ μs

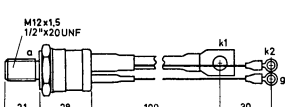
BTW33 -600RM	$I_{T(AV)}$ = 80	600	600	500				$V_T < 3$ V at $I_T = 200$ A
-800RM	$I_{T(RMS)}$ = 110	800	800	600	10	*2	125	0,3	$dV_D/dt < 200$ V/μs
-1000RM	I_{TRM} = 750	1000	1000	800		10			$I_H < 200$ mA
-1200RM	I_{TSM} = 1500	1200	1200	1000					$t_{on} < 2\ \mu s$
	$dI_T/dt = 100$								$t_q < 11\ \mu s$
	at $dI_G/dt = 1$								$*t_q < 25\ \mu s$
BTW34 -600M	$I_{T(AV)}$ = 21	700	600	600					$V_T < 2{,}1$ V at $I_T = 100$A
-800M	$I_{T(RMS)}$ = 55	900	800	800					$dV_D/dt < 200$ V/μs
-1000M	I_{TRM} = 300	1100	1000	1000		*2			$I_H < 200$ mA
-1200M	I_{TSM} = 400	1300	1200	1200		10	125	0,6	$t_{on} < 3{,}5\ \mu s$
-1400M	$dI_T/dt = 50$	1400	1400	1200					
-1600M	at $dI_G/dt = 1$	1600	1600	1200					
BTW47 -600RM(U)	$I_{T(AV)}$ = 14	700	600	600					$V_T < 3$ V at $I_T = 50$ A
-800RM(U)	$I_{T(RMS)}$ = 25	900	800	800					$*dV_D/dt < 300$ V/μs
-1000RM(U)	I_{TRM} = 150	1100	1000	1000	10	*1	125	1	$I_H < 200$ mA
-1200RM(U)	I_{TSM} = 220	1300	1200	1200		5			$I_L < 200$ mA
-1400RM(U)	$dI_T/dt = 200$	1400	1400	1200					$t_{on} = 2\ \mu s$
-1600RM(U)	(after triggering)	1600	1600	1200					$t_q < 100\ \mu s$
									$*t_q < 250\ \mu s$



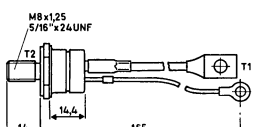
BTW30 series



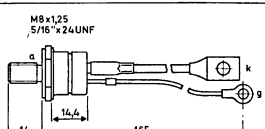
BTW31 series



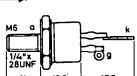
BTW33 series - M (M12)



BTW34 series - M(M8x1,25)



BTW32 series - M(M8x1,25)



BTW47 series - M(M6)
BTW47 series - U(1/4"x28UNF)

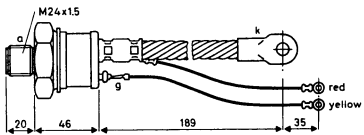
THYRISTORS

Type and application	*Ratings:* I (A) $(A/\mu s)$	V_{DSM} V_{RSM} (V)	V_{DRM} V_{RRM} (V)	V_{DWM} V_{RWM} (V)	V_{RGM} (V)	$*P_{G(AV)}$ P_{GM} (W)	T_j $(°C)$	$R_{th\,j-mb}$ $(°C/W)$	*Characteristics at $T_j = 25°C$* $*T_j = 125°C$
BTW92 -**600RM(U)**	$I_{T(AV)} = 20$	700	600	600					$V_T < 3$ V at $I_T = 50$ mA
-**800RM(U)**	$I_{T(RMS)} = 31$	900	800	800					$*dV_D/dt < 300\ V/\mu s$
-**1000RM(U)**	$I_{TRM} = 200$	1100	1000	1000	10	*1	125	1	$I_H < 200$ mA
-**1200RM(U)**	$I_{TSM} = 320$	1300	1200	1200		5			$I_L < 200$ mA
-**1400RM(U)**	$dI_T/dt = 300$	1400	1400	1200					$t_{on} = 2\ \mu s$
-**1600RM(U)**	(after triggering)	1600	1600	1200					$t_q < 100\ \mu s$
									$*t_q < 250\ \mu s$

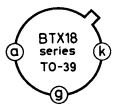
Type and applications	*Ratings:* I (A)	V_{RWM} V_{DWM} (V)	V_{DRM} (V)	V_{DSM} (V)	$*V_{FGM}$ V_{RGM} (V)	$*P_{GAV}$ P_{GM} (W)	T_j $(°C)$	$R_{th\,j-mb}$ $(°C/W)$	I_H (mA)	t_{on} (μs)	t_q (μs)
BTX18 -**100**	$I_{TAV} = 1$	100	120	120							
-**200**	$I_{T(RMS)} = 1.6$	200	240	240	*10	*0.05					
-**300**	$I_{TRM} = 10$	300	350	350	5	0.5	125	10	<5	—	20
-**400**	$I_{TSM} = 10$	400	500	500							
-**500**	$I_{FGM} = 0.2$	500	600	600							
BTX41 -**800R**	$I_{T(AV)} = 250$	800	800	900							
-**1000R**	$I_{T(RMS)} = 400$	1000	1000	1200	*6	*2					
-**1200R**	$I_{TRM} = 2500$	1200	1200	1400	5	10	110	0.12	<150	<20	200
-**1400R**	$I_{TSM} = 5500$	1400	1200	1600							
-**1600R**	$I_{FGM} = 3$	1600	1200	1800							

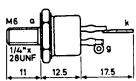
BTX94	**-400**	$I_{T(RMS)}=25$	±400	±400						
Triac	**-500**	$\pm I_{TRM}=100$	±500	±500						
	-600	$\pm I_{TSM}=250$	±600	±600	$V_{GM}=$	*1	125	1.0	1.5	—
	-800	$\pm I_{GM}=0.2$	±800	±800	±5 V	5				
	-1000		±1000	±1000						
	-1200		±1200	±1200						

Type and application	*Ratings:* I (A) $(A/\mu s)$	V_{RWM} (V)	V_{DWM} (V)	*V_{FGM} V_{RGM} (V)	*$P_{G(AV)}$ P_{GM} (W)	T_j $(°C)$	f (kHz)	$R_{th\ j-mb}$ $(°C/W)$	*Characteristics* at $T_j=25°C$ *$T_j=105°C$
BTX95-500R	$I_{T(RMS)}=15$	250	500	*10	*1	105	5	3	t_r <375 ns }
-600R	$I_{TRM}=200$	300	600	5	20				t_r <300 ns } at $I_{TM}=$
-700R	$dI_T/dt=1000$	350	700						t_r <250 ns } 40 A
-800R	(after triggering)	400	800						t_r <220 ns }
pulse modulator	$dI_T/dt=50$								V_T <3 V at $I_T=10$ A
radar	(after breakover)								*t_q <50 µs
	$I_{FGM}=5$								

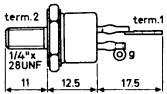


BTX41 series

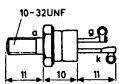




BTW92 series -M (M6)
BTW92 series -U (1/4"x28UNF)



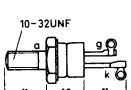
BTX94 series TO-48



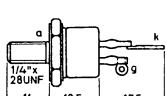
BTX95 series

THYRISTORS

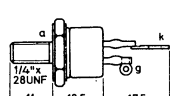
Type and applications	*Ratings:* I (A)	V_{RWM} V_{DWM} (V)	V_{DRM} (V)	V_{DSM} (V)	$*V_{FGM}$ V_{RGM} (V)	$*P_{GAV}$ P_{GM} (W)	T_j (°C)	$R_{th\ j-mb}$ (°C/W)	I_H (mA)	t_{on} (μs)	t_q (μs)
BTY79 -400R	I_{TAV} = 6.4	400	400	500	*10 5	*0.5 5	125	3.0	10	3	< 50
-500R	$I_{T(RMS)}$ = 10	500	500	1100							
-600R	I_{TRM} = 60	600	600	1100							
-800R	I_{TSM} = 80	800	800	1100							
-1000R	I_{FGM} = 2	1000	1000	1100							
BTY87 -400R	I_{TAV} = 12	400	400	500	*10 5	*0.5 5	125	1.6	10	2	< 50
-500R	$I_{T(RMS)}$ = 19	500	500	850							
-600R	I_{TRM} = 140	600	600	850							
-800R	I_{TSM} = 140	800	800	850							
	I_{FGM} = 2										
BTY91 -400R	I_{TAV} = 16	400	400	500	*10 5	*0.5 5	125	1.6	10	2	< 50
-500R	$I_{T(RMS)}$ = 25	500	500	850							
-600R	I_{TRM} = 200	600	600	850							
-800R	I_{TSM} = 200	800	800	850							
	I_{FGM} = 2										



BTY79 series



BTY87 series



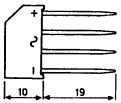
BTY91 series

IGNISTOR

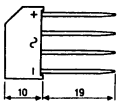
Type and applications	*Ratings:* I (A)	V_{RWM} V_{DWM} (V)	V_{DRM} (V)	V_{DSM} (V)	$*V_{FGM}$ V_{RGM} (V)	$*P_{GAV}$ P_{GM} (W)	T_j $(°C)$	$R_{th\,j-w}$ $(°C/W)$	I_H (mA)	t_{on} (μs)	t_q (μs)
OTH1200 -800	$I_{T(RMS)} = 12$	600	800	800	5	*3	125	0,1	500	5	250
-1000	$I_{TSM} = 7$	700	1000	1000		16					
-1200	$dI_T/dt = 100$	800	1200	1200							
-1400	(after triggering)	1000	1400	1400							

RECTIFIER STACKS

Type and applications	*Ratings*								
	I_O (*A*)	I_{ORM} (*A*)	I_{FSM} (*A*)	$V_{I(RMS)}$ (*V*)	V_{IWM} (*V*)	V_{IRM} (*V*)	V_{FSM} (*V*)	P_{IRM} (*kW*)	P_{FSM} (*kW*)
BY164	1.4	5	25	60	85	120	120	—	—
BY179	1	5	25	280	400	800	800	—	—



BY164

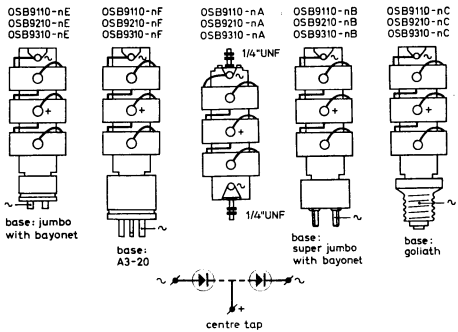


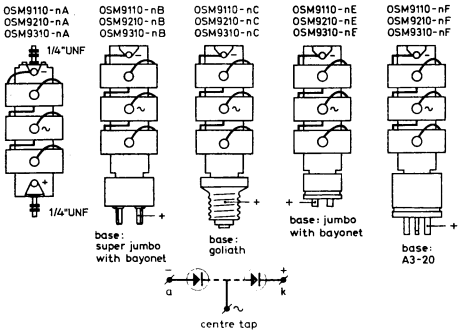
BY179

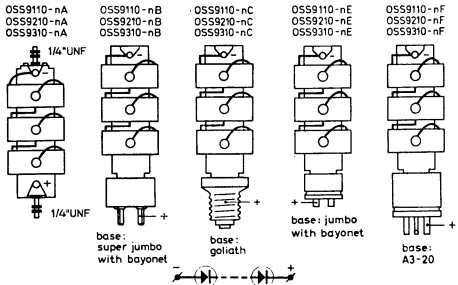
Type and application	*Ratings*						*Characteristics*					
	$I_{F(AV)}$ (*A*)	I_{FRM} (*A*)	I_{FSM} (*A*)	V_{RWM} (*V*)	P_{RRM} (*kW*)	P_{RSM} (*kW*)	V_F at (*V*)	I_F (*A*)	$V_{(BR)R}$ at (*kV*)	I_R (*mA*)	I_{RM} at (*A*)	V_{RM} (*V*)
OSB9110 -4				2	1.2	6	<4	20	<3.76	5		
-6				3	1.8	9	<6	20	<5.64	5		
...	6	120	85	...	...	...	...	...	...	...	<0.6	V_{RWMmax}
-28				14	8.4	42	<28	20	<26.32	5		
-30				15	9	45	<30	20	<28.2	5		
OSM9110 series Equivalent to OSB9110 series												
OSS9110 -3				3	1.8	9	<6	20	<5.64	5		
-4				4	2.4	12	<8	20	<7.52	5		
...	6	120	85	...	...	...	...	...	...	...	<0.6	V_{RWMmax}
-29				29	17.4	87	<58	20	<54.52	5		
-30				30	18	90	<60	20	<56.4	5		
OSB9210 -4				2	4	26	<3.6	50	<3.76	5		
-6				3	6	39	<5.4	50	<5.64	5		
...	20	440	360	...	...	...	...	...	...	...	<0.6	V_{RWMmax}
-28				14	28	182	<25.2	50	<26.32	5		
-30				15	30	195	<27	50	<28.2	5		
OSM9210 series Equivalent to OSB9210 series												
OSS9210 -3				3	6	39	<5.4	50	<5.64	5		
-4				4	8	52	<7.2	50	<7.52	5		
...	20	440	360	...	...	...	...		...	...	<0.6	V_{RWMmax}
-29				29	58	377	<52.2	50	54.52	5		
-30				30	60	390	<54	50	56.4	5		

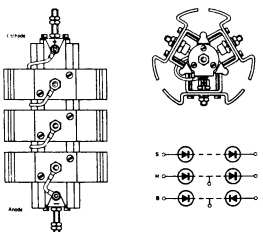
RECTIFIER STACKS

Type and application	Ratings						Characteristics					
	$I_{F(AV)}$ (A)	I_{FRM} (A)	I_{FSM} (A)	V_{RWM} (V)	P_{RRM} (kW)	P_{RSM} (kW)	V_F at I_F (V)	(A)	$V_{(BR)R}$ at I_R (kV)	(mA)	I_{RM} at (A)	V_{RM} (V)
OSB9310 -4				2	2	12	<5	50	<4	5		
-6				3	3	18	<7.5	50	<6	5		
...	12	250	180	...	...	...	...	...	...	...	<0.3	V_{RWMmax}
-28				14	14	84	<35	50	<28	5		
-30				15	15	90	<37.5	50	<30	5		
OSM9310 series Equivalent to OSB9310 series												
OSS9310 -3				3	3	18	<7.5	50	<6	5		
-4				4	4	24	<10	50	<8	5		
...	12	250	180	...	...	...	...	...	...	...	<0.3	V_{RWMmax}
-29				29	29	174	<72.5	50	<58	5		
-30				30	30	180	<75	50	<60	5		
OSB9410 -4				2	9	55	<3.6	150	<4	5		
-6				3	13.5	80	<5.4	150	<6	5		
...	10	450	800	...	...	...	...	...	...	...	<1.6	V_{RWMmax}
-28				14	63	375	25.2	150	<20	5		
-30				15	67.5	400	27	150	<30	5		
OSM9410 series Equivalent to OSB9410 series												
OSS9410 -3				3	13.5	80	<5.4	150	<6	5		
-4				4	18	105	<7.2	150	<8	5		
...	10	450	800	...	...	...	...	...	...	...	<1.6	V_{RWMmax}
-29				29	130.5	775	<52.2	150	<58	5		
-30				30	135	800	<54	150	<60	5		









The drawing shows the OSS9410.

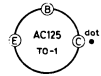
The OSB9410 and OSM9410 differ in the following respects:

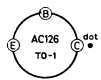
OSB9410 - has a centre top marked +;
anode and cathode are marked ~.

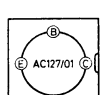
OSM9410 - has a centre top marked ~.

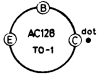
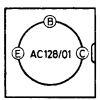
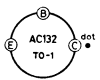
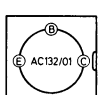
LOW FREQUENCY TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	*Characteristics at:*	I_E (*mA*)	V_{CB} (*V*)	*Ratings*	*Outlines (mm)*
AC125 p-n-p driver	$h_{FE} = 100$ $f_T = 1.7$ MHz $F < 10$ dB $h_{fe} < 170$	−2 −10 −0.5 −2	−5 −2 −5 −5	$-I_{CBO} < 10\ \mu A$ $C_c < 50$ pF	0 0	−10 −5	$-I_C = 100$ mA $-V_{CEO} = 12$ V $P_{tot} = 500$ mW $T_j = 90°C$ $R_{th\,j-a} = 0.3°C/mW$	length < 9.4 width < 6.1 leads > 38
AC126 p-n-p driver	$h_{FE} = 140$ $f_T = 2.3$ MHz $F < 10$ dB $h_{fe} < 300$	−2 −10 −0.5 −2	−5 −2 −5 −5	$-I_{CBO} < 10\ \mu A$ $C_c < 50$ pF	0 0	−10 −5	$-I_C = 100$ mA $-V_{CEO} = 12$ V $P_{tot} = 500$ mW $T_j = 90°C$ $R_{th\,j-a} = 0.3°C/mW$	length < 9.4 width < 6.1 leads > 38
AC127 n-p-n driver output	$h_{FE} = 100$ $f_T = 2.5$ MHz $F < 10$ dB	20 10 0.5	0.6 2 5	$I_{CBO} < 15\ \mu A$ $C_c = 70$ pF	0 0	10 5	$I_C = 0.5$ A $V_{CEO} = 12$ V $P_{tot} = 340$ mW $T_j = 90°C$ $R_{th\,j-a} = 0.37°C/mW$	length < 9.4 width < 6.4 leads > 38
AC127/AC128 matched pair	$h_{FE1}/h_{FE2} = 1.1$	|300|	0.6					
AC127/AC132 matched pair	$h_{FE1}/h_{FE2} = 1.1$	|50|	0.6					
AC127/01	Equivalent to AC127 except for:						$R_{th\,j-a} = 0.25°C/mW$	length < 15.7 width < 7.2 leads > 38



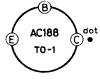


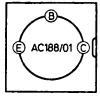


AC128	$h_{FE} < 175$	-50	0.6	$-I_{CBO} < 10\ \mu A$	0	-10	$-I_{CM} = 2$ A	length < 9.4	
p-n-p	$f_T = 1.5$ MHz	-10	-2	$-I_{CBO} < 0.2$ mA	0	-32	$-V_{CEO} = 16$ V	width < 6.4	
output	$h_{fe} = 1.25$	-60	-9	$C_c = 100$ pF	0	-5	$P_{tot} = 1$ W	leads > 38	
							$T_j = 90°C$		
							$R_{th\,j-a} = 0.29°C/mW$		
2-AC128 matched pair	$h_{FE1}/h_{FE2} = 1.1$	-300	0.6						
AC128/01	Equivalent to AC128 except for:						$R_{th\,j-a} = 0.18°C/mW$	length < 15.7	
								width < 7.2	
								leads > 38	
AC132	$h_{FE} = 135$	-20	0	$-I_{CBO} < 10\ \mu A$	0	-0.5	$-I_C = 200$ mA	length < 9.4	
p-n-p	$f_T = 2$ MHz	-10	-2	$V_{EB} < 0.55$ V	200	0	$-V_{CEO} = 12$ V	width < 6.1	
output	$F < 10$ dB	-0.5	-5	$C_c = 40$ pF	0	-5	$P_{tot} = 500$ mW	leads > 38	
							T_j 90°C		
							$R_{th\,j-a} = 0.30°C/mW$		
2-AC132 matched pair	$h_{FE1}/h_{FE2} = 1.1$	-200	0.6						
AC132/01	Equivalent to AC132 except for:						$R_{th\,j-a} = 0.19°C/mW$	length < 1.57	
								width < 7.2	
								leads > 38	
AC172	$h_{FE} = 110$	1	5	$I_{CBO} < 10\ \mu A$	0	10	$I_C = 10$ mA	length < 9.4	
n-p-n	$f_T = 2.5$ MHz	10	2	$C_c = 70$ pF	0	5	$V_{CEO} = 12$ V	width < 6.1	
pre-amplifier	$F < 4$ dB	0.5	5				$P_{tot} = 200$ mW	leads > 38	
	$h_{fe} < 110$	0.5	5				$T_j = 90°C$		
							$R_{th\,j-a} = 0.37°C/mW$		

LOW FREQUENCY TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
AC187	V_{BE} < 135 mV	5	10	I_{CBO} < 0.1 mA	0	25	I_{CM} = 2 A	length < 9.4
n-p-n	h_{FE} > 70	5	10	C_c < 180 pF	0	5	V_{CEO} = 15 V	width < 6.1
medium	h_{FE} < 500	300	1				P_{tot} = 1 W	leads > 38
power	f_T = 5 MHz	10	2				T_j = 90°C	
							$R_{th\,j-a}$ = 0.29°C/mW	
AC187/AC188 matched pair	h_{FE1}/h_{FE2} < 1.25	|500|	|1|					
AC187/01	Equivalent to AC187 except for:						$R_{th\,j-a}$ = 0.18°C/mW	length < 15.7 width < 7.2 leads > 38
AC188	$-V_{BE}$ < 145 mV	−5	−10	$-I_{CBO}$ < 0.2 mA	0	−25	$-I_{CM}$ = 2 A	length < 9.4
p-n-p	h_{FE} > 70	−5	−10	C_c < 110 pF	0	−5	$-V_{CEO}$ = 15 V	width < 6.1
medium	h_{FE} < 500	−300	−1				P_{tot} = 1 W	leads > 38
power	f_T = 1.5 MHz	−10	−2				T_j = 90°C	
							$R_{th\,j-a}$ = 0.29°C/mW	
AC188/01	Equivalent to AC188 except for:						$R_{th\,j-a}$ = 0.18°C/mW	length < 15.1 width < 7.2 leads > 38





BC107(-A)(-B)	$A: h_{FE} < 220$	2	5	$I_{CBO} < 15\ \mu A$	0	20	I_{CM} = 200 mA	length < 5.3	
n-p-n	$B: h_{FE} < 450$	2	5	C_c < 4.5 pF	0	10	V_{CEO} = 45 V	width < 4.8	
driver	$h_{fe} < 500$	2	5				P_{tot} = 300 mW	leads > 12.7	
	f_T = 300 MHz	10	5				T_j = 175°C		
	F = 2 dB	0.2	5				$R_{th\,j-a}$ = 0.5°C/mW		

BC108(-A)(-B)(-C)									
Equivalent to	$A, B: h_{fe} < 900$	2	5				V_{CEO} = 20 V		
BC107(-A)(-B)	C: $h_{FE} < 800$	2	5						
except for:									

BC109(-B)(-C)	$B: h_{FE} < 450$	2	5	$I_{CBO} < 15\ \mu A$	0	20	I_{CM} = 200 mA	length < 5.3	
n-p-n	$C: h_{FE} < 800$	2	5	C_c < 4.5 pF	0	10	V_{CEO} = 20 V	width < 4.8	
input	$h_{FE} < 900$	2	5				P_{tot} = 300 mW	leads > 12.7	
	f_T = 300 MHz	10	5				T_j = 175°C		
	F < 4 dB	0.2	5				$R_{th\,j-a}$ = 0.5°C/mW		

LOW FREQUENCY TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
BC146	Equivalent to BC112 except for: V_{BE} = 0.63 V	2	1					
BC147 n-p-n driver	h_{fe} < 500 f_T = 300 MHz F = 2 dB	2 10 0.2	5 5 5				I_{CM} = 200 mA V_{CEO} = 45 V P_{tot} = 250 mW T_j = 125°C $R_{th\,j-a}$ = 0.45°C/mW	height < 5.1 width < 7.6 depth < 4.6 leads < 5.5	
BC148 n-p-n driver jungle	h_{fe} < 900 f_T = 300 MHz F = 2 dB	2 10 0.2	5 5 5				I_{CM} = 200 mA V_{CEO} = 20 V P_{tot} = 250 mW T_j = 125°C $R_{th\,j-a}$ = 0.45°C/mW	height < 5.1 width < 7.6 depth < 4.6 leads < 5.5	
BC149 n-p-n input hi-fi	h_{fe} < 900 f_T = 300 MHz F < 4	2 10 0.2	5 5 5				I_{CM} = 200 mA V_{CEO} = 20 V P_{tot} = 250 mW T_j = 125°C $R_{th\,j-a}$ = 0.45°C/mW	height < 5.1 width < 7.6 depth < 4.6 leads < 5.5	
BC157 p-n-p driver	h_{FE} = 140 h_{fe} < 260 f_T = 150 MHz F = 2 dB	−2 −2 −10 −0.2	−5 −5 −5 −5	$-I_{CBO}$ = 1 nA C_c = 4.5 pF	0 0	−20 −10	$-I_C$ = 100 mA $-V_{CEO}$ = 45 V P_{tot} = 250 mW T_j = 125°C $R_{th\,j-a}$ = 0.4°C/mW	height < 5.1 width < 7.6 depth < 4.6 leads < 5.5	

BC158(-A)(-B)	A: $h_{FE}=180$	-2	-5	$-I_{CBO}=1$ nA	0	-20	$-I_C$ $=100$ mA	height <5.1
p-n-p	B: $h_{FE}=290$	-2	-5	C_c $=4.5$ pF	0	-10	$-V_{CEO}=25$ V	width <7.6
driver	A: $h_{fe}<260$	-2	-5				P_{tot} $=250$ mW	depth <4.6
	B: $h_{fe}<500$	-2	-5				T_j $=125$°C	leads <5.5
	$f_T=150$ MHz	-10	-5				$R_{th\,j-a}=0.4$°C/mW	
	$F=2$ dB	-0.2	-5					

BC158

BC159(-A)(-B)	A: $h_{FE}=180$	-2	-5	$-I_{CBO}=1$nA	0	-20	$-I_C$ $=100$ mA	height <5.1
p-n-p	B: $h_{FE}=290$	-2	-5	C_c $=4.5$ pF	0	-10	$-V_{CEO}=20$ V	width <7.6
input	A: $h_{fe}<260$	-2	-5				P_{tot} $=250$ mW	depth <4.6
hi-fi	B: $h_{fe}<500$	-2	-5				T_j $=125$°C	leads <5.5
	$f_T=150$ MHz	-10	-5				$R_{th\,j-a}=0.4$°C/mW	
	$F=1$ dB	-0.2	-5					

BC159

BC177	$-V_{BE}<0.75$ V	-2	-5	$-I_{CBO}<100$ nA	0	-20	$-I_{CM}$ $=200$ mA	length <5.3
p-n-p	$h_{FE}=140$	-2	-5	C_c $=4{,}0$ pF	0	-10	$-V_{CEO}=45$ V	width <4.8
driver	F <10 dB	0.2	-5				P_{tot} $=300$ mW	leads >12.7
audio ampl.	f_T $=150$ MHz	-10	-5				T_j $=175$°C	
	$h_{fe}<260$	-2	-5				$R_{th\,j-a}=0.5$°C/mW	

BC178(-A)	Equivalent to BC177 except for:						$-V_{CEO}=25$ V	
	$h_{FE}=180$	-2	-5					

BC178(-B)	Equivalent to BC177 except for:						$-V_{CEO}=25$ V	
	$h_{FE}=290$	-2	-5					
	$h_{fe}<500$	-2	-5					

LOW FREQUENCY TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	*Characteristics at:*	I_E (*mA*)	V_{CB} (*V*)	*Ratings*	*Outlines (mm)*
BC179(-A)	Equivalent to BC178(-A) except for:						$-V_{CEO}=20$ V	
	$F<4$ dB	-0.2	-5					
BC179(-B)	Equivalent to BC178(-B) except for:						$-V_{CEO}=20$ V	
	$F<4$ dB	-0.2	-5					
BC200	$-V_{BE}=650$ mV	-2	-1	$-I_{CBO}<100$ nA	0	-20	$-I_C=50$ mA	
p-n-p	$h_{FE}>60$	-2	-1	$C_c=5$ pF	0	-5	$-V_{CEO}=20$ V	
red dot	$h_{fe}=75$	-0.2	-0.5				$P_{tot}=50$ mW	
hearing aids	$f_T=90$ MHz	-2	-5				$T_j=125$°C	
	$F=2$ dB	-0.2	-5				$R_{th\,j-a}=1.6$ °C/mW	
BC200	$-V_{BE}=650$ mV	-2	-1	$-I_{CBO}<100$ nA	0	-20	$-I_C=50$ mA	length <1.8
p-n-p	$h_{FE}>100$	-2	-1	$C_c=5$ pF	0	-5	$-V_{CEO}=20$ V	width <1.8
yellow dot	$h_{fe}=140$	-0.2	-0.5				$P_{tot}=50$ mW	leads >12
hearing aids	$f_T=90$ MHz	-2	-5				$T_j=125$°C	
	$F=1.5$ dB	-0.2	-5				$R_{th\,j-a}=1.6$°C/mW	
BC200	$-V_{BE}=650$ mV	-2	-1	$-I_{CBO}<100$ nA	0	-20	$-I_C=50$ mA	
p-n-p	$h_{FE}>175$	-2	-1	$C_c=5$ pF	0	-5	$-V_{CEO}=20$ V	
green dot	$h_{fe}=250$	-0.2	-0.5				$P_{tot}=50$ mW	
hearing aids	$f_T=90$ MHz	-2	-5				$T_j=125$°C	
	$F=2$ dB	-0.2	-5				$R_{th\,j-a}=1.6$°C/mW	

BC237(-A)(-B)	V_{BE} < 770 mV	10	5	I_{CBO} < 5 μA	0	20	I_C = 100 mA	length < 5.2	
n-p-n	A; h_{FE} = 180	2	5	C_c < 4,5 pF	0	10	V_{CEO} = 45 V	width < 5.2	
driver	B; h_{FE} = 290	2	5				P_{tot} = 300 mW	leads > 12.7	
audio ampl.	A; h_{fe} = 220	2	5				T_j = 125°C		
	B; h_{fe} = 330	2	5				$R_{th\,j-a}$ = 0.33°C/mW		
	F = 2 dB	0.2	5						
	f_T = 300 MHz	10	5						
BC238	V_{BE} < 770 mV	10	5	I_{CBO} < 5 μA	0	20	I_C = 100 mA	length < 5.2	
(-A)(-B)(-C)	A; h_{FE} = 180	2	5	C_c < 4,5 pF	0	10	V_{CEO} = 20 V	width < 5.2	
n-p-n	B; h_{FE} = 290	2	5				P_{tot} = 300 mW	leads > 12.7	
driver	C; h_{FE} = 520	2	5				T_j = 125°C		
audio ampl.	A; h_{fe} = 220	2	5				$R_{th\,j-a}$ = 0.33°C/mW		
television	B; h_{fe} = 330	2	5						
	C; h_{fe} = 600	2	5						
	F = 2 dB	0.2	5						
	f_T = 300 MHz	10	5						
BC239(-B)(-C)	V_{BE} < 770 mV	10	5	I_{CBO} < 5 μA	0	20	I_C = 100 mA	length < 5.2	
n-p-n	B; h_{FE} = 290	2	5	C_c < 4,5 pF	0	10	V_{CEO} = 20 V	width < 5.2	
input	C; h_{FE} = 520	2	5				P_{tot} = 300 mW	leads > 12.7	
hi-fi	B; h_{FE} = 330	2	5				T_j = 125°C		
	C; h_{fe} = 600	2	5				$R_{th\,j-a}$ = 0.33°C/mW		
	F = 1.2 dB	0.2	5						
	f_T = 300 MHz	10	5						
BC307	$-V_{BE}$ = 650 mV	−2	−5	$-I_{CBO}$ < 5 μA	0	−20	$-I_C$ = 100 mA	length < 5.2	
p-n-p	h_{FE} = 140	−2	−5	C_c = 4,5 pF	0	−10	$-I_{CM}$ = 200 mA	width < 5.2	
driver	h_{fe} > 75	−2	−5				$-V_{CEO}$ = 45 V	leads > 12.7	
audio ampl.	h_{fe} < 260	−2	−5				P_{tot} = 300 mW		
television	f_T = 150 MHz	−10	−5				T_j = 125°C		
	F = 2 dB	−0.2	−5				$R_{th\,j-a}$ = 0.33°C/mW		

LOW FREQUENCY TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	*Characteristics at:*	I_E (*mA*)	V_{CB} (*V*)	*Ratings*	*Outlines (mm)*
BC308(-A)(-B)	$-V_{BE}=650$ mV	−2	−5	$-I_{CBO}<5$ μA	0	−20	$-I_C$ = 100 mA	length < 5.2
p-n-p	*A*: $h_{FE}=180$	−2	−5	C_c = 4.5 pF	0	−10	$-I_{CM}$ = 200 mA	width < 5.2
driver	*B*: $h_{FE}=290$	−2	−5				$-V_{CEO}$ = 25 V	leads > 12.7
audio pre-ampl.	*A*: $h_{fe}>125$	−2	−5				P_{tot} = 300 mW	
television	*A*: $h_{fe}<260$	−2	−5				T_j = 125°C	
	B: $h_{fe}>240$	−2	−5				$R_{th\,j-a}$ = 0.33°C/mW	
	B: $h_{fe}<500$	−2	−5					
	f_T = 150 MHz	−10	−5					
	F = 2 dB	−0.2	−5					
BC309(-A)(-B)	$-V_{BE}=650$ mV	−2	−5	$-I_{CBO}<5$ μA	0	−20	$-I_C$ = 100 mA	length < 5.2
p-n-p	*A*: $h_{FE}=180$	−2	−5	C_c = 4.5 pF	0	−10	$-I_{CM}$ = 200 mA	width < 5.2
input stages	*B*: $h_{FE}=290$	−2	−5				$-V_{CEO}$ = 20 V	leads > 12.7
tape recorders	*A*: $h_{fe}>125$	−2	−5				P_{tot} = 300 mW	
hi-fi ampl.	*A*: $h_{fe}<260$	−2	−5				T_j = 125°C	
general audio	*B*: $h_{fe}>240$	−2	−5				$R_{th\,j-a}$ = 0.33°C/mW	
	B: $h_{fe}<500$	−2	−5					
	f_T = 150 MHz	−10	−5					
	F = 1 dB	−0.2	−5					
BC327	$-V_{BE}<1.2$ V	−500	−1	$-I_{CBO}<100$ nA	0	−20	$-I_C$ = 500 mA	length < 5.2
p-n-p	$h_{FE}>100$	−100	−1	(T_j = 25°C)			$-I_{CM}$ = 1000 mA	width < 4.8
driver	$h_{FE}>40$	−500	−1	$-I_{CBO}<5$ μA	0	−20	$-V_{CEO}$ = 45 V	leads > 12.7
audio ampl.	f_T = 100 MHz	−10	−5	(T_j = 150°C)			P_{tot} = 500 mW	
				C_c = 8 pF	0	−10	T_j = 150°C	
							$R_{th\,j-a}$ = 0.25°C/mW	
BC327/BC337 matched pair	$h_{FE1}/h_{FE2}=1.25$	|100|	|1|					

BC328	Equivalent to BC327 except for:						$-V_{CEO}=25$ V	
BC328/BC338 matched pair	$h_{FE1}/h_{FE2}=1.25$	|100|	|1|					
BC337	$V_{BE}<1.2$ V	300	1	$I_{CBO}<100$ nA	0	20	I_C = 500 mA	length < 5.2
n-p-n	$h_{FE}>100$	100	1	(T_j = 25°C)			I_{CM} = 1000 mA	width < 4.8
driver	$h_{FE}>40$	300	1	$I_{CBO}<5$ μA	0	20	$V_{CEO}=45$ V	leads > 12.7
audio ampl.	f_T = 200 MHz	10	5	(T_j = 150°C)			P_{tot} = 500 mW	
				C_c = 5 pF	0	10	T_j = 150°C	
							$R_{th\,j-a}=0.25$°C/W	
BC338	Equivalent to BC227 except for:						$V_{CEO}=25$ V	
BC547(A)(B)	$V_{BE}<700$ mV	2	5	$I_{CBO}<5$ μA	0	20	I_C = 100 mA	length < 5,2
n-p-n	A: $h_{FE}=180$	2	5	C_c <4,5 pF	0	10	I_{CM} = 200 mA	width < 4,8
driver	B: $h_{FE}=290$	2	5				V_{CEO} = 45 V	leads > 12,7
	A: h_{fe} 125-260	2	5				P_{tot} = 300 mW	
	B: h_{fe} 240-500	2	5				T_j = 150°C	
	$f_T=300$ MHz	10	5				$R_{th\,j-a}=0{,}25$°C/mW	
	$F=2$ dB	0.2	5					
BC548(A)(B)(C)	$V_{BE}<700$ mV	2	5	$I_{CBO}<5$ μA	0	20	I_C = 100 mA	length < 5,2
n-p-n	A: $h_{FE}=180$	2	5	C_c <4,5 pF	0	10	I_{CM} = 200 mA	width < 4,8
pre-amplifier	B: $h_{FE}=290$	2	5				V_{CEO} = 20 V	leads > 12,7
driver	C: $h_{FE}=520$	2	5				P_{tot} = 300 mW	
	A: h_{fe} 125-260	2	5				T_j = 150°C	
	B: h_{fe} 240-500	2	5				$R_{th\,j-a}=0{,}4$°C/mW	
	C: h_{fe} 450-900	2	5					
	$f_T=300$ MHz	10	5					
	$F=2$ dB	0,2	5					

LOW FREQUENCY TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at-	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
BC549(B)(C)	Equivalent to BC548(B)(C) except for:							
	$F = 1{,}2$ dB	0,2	5					
BC557	$-V_{BE} < 750$ mV	-2	-5	$-I_{CBO} < 100$ nA	0	-20	$-I_C = 100$ mA	length < 5,2
p-n-p	$h_{FE} = 140$	-2	-5	$C_c = 4{,}5$ pF	0	-10	$-I_{CM} = 200$ mA	width < 4,8
driver	h_{fe} 75-260	-2	-5				$-V_{CEO} = 25$ V	leads > 12,7
	$f_T = 150$ MHz	-10	-5				$P_{tot} = 300$ mW	
	$F = 2$ dB	$-0{,}2$	-5				$T_j = 150$°C	
		(B = 200 Hz)					$R_{th\,j-a} = 0{,}25$°C/mW	
BC558(A)(B)	$-V_{BE} < 750$ mV	-2	-5	$-I_{CBO} < 100$ nA	0	-20	$-I_C = 100$ mA	length < 5,2
p-n-p	A: $h_{FE} = 180$	-2	-5	$C_c = 4{,}5$ pF	0	-10	$-I_{CM} = 200$ mA	width < 4,8
pre-amplifier	B: $h_{FE} = 290$	-2	-5				$-V_{CEO} = 25$ V	leads > 12,7
driver	A: h_{fe} 125-260	-2	-5				$P_{tot} = 300$ mW	
	B: h_{fe} 240-500	-2	-5				$T_j = 150$°C	
	$f_T = 150$ MHz	-10	-10				$R_{th\,j-a} = 0{,}25$°C/mW	
	$F = 2$ dB	$-0{,}2$	-5					
BC559(A)(B)	Equivalent to BC558(A)(B) except for:							
p-n-p	$F = 1$ dB	$-0{,}2$	-5				$-V_{CO} = 20$ V	
low noise pre-amplifier								

BCW46(-A)(-B)	$V_{BE}<770$ mV	10	5	$I_{CBO}<10\ \mu A$	0	80	I_C = 100 mA	length < 7.62
n-p-n	A: $h_{FE}=215$	10	5	C_c = 2.5 pF	0	10	I_{CM} = 200 mA	width < 2.5
amplifier and	B: $h_{FE}=340$	10	5				V_{CEO} = 60 V	height < 6.5
switching	A: $h_{fe}>125$	2	5				P_{tot} = 200 mW	leads > 2.3
applications	B: $h_{fe}>240$	2	5				T_j = 150°C	
	$f_T=300$ MHz	10	5				$R_{th\,j-a}$ = 0.5°C/mW	

BCW46

E B C

BCW47(-A)(-B)	Equivalent to BCW46 except for-			$I_{CBO}<10\ \mu A$	0	50	V_{CEO} = 45 V	

BCW48	$V_{BE}<770$ mV	10	5	$I_{CBO}<10\ \mu A$	0	30	I_C = 100 mA	length < 7.62
(-A)(-B)(-C)	A: $h_{FE}=215$	10	5	C_c = 2.5 pF	0	10	I_{CM} = 200 mA	width < 2.5
n-p-n	B: $h_{FE}=340$	10	5				V_{CEO} = 20 V	height < 6.5
amplifier and	C: $h_{FE}=600$	10	5				P_{tot} = 200 mW	leads > 2.3
switching	A: $h_{fe}>125$	2	5				T_j = 150°C	
applications	B: $h_{fe}>240$	2	5				$R_{th\,j-a}$ = 0.5°C/mW	
	C: $h_{fe}>450$	2	5					
	$f_T=300$ MHz	10	5					

BCW48

E B C

BCW49(-B)(-C)	$V_{BE}<770$ mV	10	5	$I_{CBO}<10\ \mu A$	0	30	I_C = 100 mA	length < 7.62
n-p-n	B: $h_{FE}=340$	10	5	C_c = 2.5 pF	0	10	I_{CM} = 200 mA	width < 2.5
amplifier and	C: $h_{FE}=600$	10	5				V_{CEO} = 20 V	height < 6.5
switching	B: $h_{fe}>240$	2	5				P_{tot} = 200 mW	leads > 2.3
applications	C: $h_{fe}>450$	2	5				T_j = 150°C	
	$f_T=300$ MHz	10	5				$R_{th\,j-a}$ = 0.5°C/mW	
	F = 1.2 dB	0.2	5					

BCW49

E B C

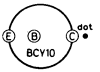
BCW56(-A)	$-V_{BE}=690$ mV	−10	−5	$-I_{CBO}<10\ \mu A$	0	−80	$-I_C$ = 100 mA	length < 7.62
p-n-p	A: $h_{FE}=180$	−10	−5	C_c = 4.5 pF	0	−10	$-I_{CM}$ = 200 mA	width < 2.5
amplifier and	A: $h_{fe}>125$	−2	−5				$-V_{CEO}$ = 60 V	height < 6.5
switching	$f_T=150$ MHz	−10	−5				P_{tot} = 200 mW	leads > 2.3
applications							T_j = 150°C	
							$R_{th\,j-a}$ = 0.5°C/mW	

BCW56

E B C

LOW FREQUENCY TRANSISTORS

Type and applications	*Characteristics at:*	I_C *(mA)*	V_{CE} *(V)*	*Characteristics at:*	I_E *(mA)*	V_{CB} *(V)*	*Ratings*	*Outlines (mm)*
BCW57(-A)	Equivalent to BCW56 except for:			$-I_{CBO}<10\ \mu A$	0	−50	$-V_{CEO}=45$ V	
BCW58(-A)(-B)	$-V_{BE}=690$ mV	−10	−5	$-I_{CBO}<10\ \mu A$	0	−30	$-I_C$ = 100 mA	length < 7.62
p-n-p	*A*: $h_{FE}=180$	−10	−5	C_c = 4.5 pF	0	−10	$-I_{CM}$ = 200 mA	width < 2.5
amplifier and	*B*: $h_{FE}=290$	−10	−5				$-V_{CEO}=20$ V	height < 6.5
switching	*A*: $h_{fe}>125$	−2	−5				P_{tot} = 200 mW	leads > 2.3
applications	*B*: $h_{fe}>240$	−2	−5				T_j = 150°C	
	$f_T=150$ MHz	−10	−5				$R_{th\,j-a}=0.5$°C/mW	
BCW59(-A)(-B)	$-V_{BE}=690$ mV	−10	−5	$-I_{CBO}<10\ \mu A$	0	−30	$-I_C$ = 100 mA	length < 7.62
	A: $h_{FE}=180$	−10	−5	C_c = 4.5 pF	0	−10	$-I_{CM}$ = 200 mA	width < 2.5
	B: $h_{FE}=290$	−10	−5				$-V_{CEO}=20$ V	height < 6.5
	A: $h_{fe}>125$	−2	−5				P_{tot} = 200 mW	leads > 2.3
	B: $h_{fe}>240$	−2	−5				T_j = 150°C	
	$f_T=150$ MHz	−10	−5				$R_{th\,j-a}=0.5$°C/mW	
	$F=1$ dB	−0.2	−5					
BCY10	$h_{FE}=24$	−30	−2	$-I_{CBO}<100$ nA	0	−6	$-I_{CM}$ = 500 mA	length < 15.7
p-n-p	$h_{FE}=15$	−150	−1				$-V_{CES}=32$ V	width < 6.0
medium	f_T = 1.5 MHz	−1	−6				P_{tot} = 415 mW	leads > 37
power	F < 20 dB	0.5	−2				T_j = 150°C	
	$h_{fe}=40$	−10	−6				$R_{th\,j-a}=0.4$°C/mW	
BCY11	Equivalent to BCY10 except for:						$-V_{CES}=60$ V	



BCY12	Equivalent to BCY10 except for:								
	$h_{FE}=40$	-30	-2						
	$h_{FE}=25$	-150	-1						
	$f_T=2$ MHz	-1	-6						
BCY30	$h_{FE}<35$	-20	-4.5	$-I_{CBO}<50$ nA	0	-6	$-I_{CM}=100$ mA	length <6.6	
p-n-p	$f_T=1.2$ MHz	-1	-6	$C_c<60$ pF	0	-6	$-V_{CEO}=50$ V	width <9.4	
switch	$h_{fe}<35$	-1	-6				$P_{tot}=250$ mW	leads >38	
general	$F<20$ dB	-0.5	-2				$T_j=150°C$		
							$R_{th\,j-a}=0.5°C/mW$		
BCY31	$h_{FE}<60$	-20	-4.5	$-I_{CBO}<50$ nA	0	-6	$-I_{CM}=100$ mA	length <6.6	
p-n-p	$f_T=1.7$ MHz	-1	-6	$C_c<60$ pF	0	-6	$-V_{CEO}=50$ V	width <9.4	
switch	$h_{fe}<60$	-1	-6				$P_{tot}=250$ mW	leads >38	
general	$F<20$ dB	-0.5	-2				$T_j=150°C$		
							$R_{th\,j-a}=0.5°C/mW$		
BCY32	$h_{FE}<70$	-20	-4.5	$-I_{CBO}<50$ nA	0	-6	$-I_{CM}=100$ mA	length <6.6	
p-n-p	$f_T=2.5$ MHz	-1	-6	$C_c<60$ pF	0	-6	$-V_{CEO}=50$ V	width <9.4	
switch	$h_{fe}<80$	-1	-6				$P_{tot}=250$ mW	leads >38	
general	$F<20$ dB	-0.5	-2				$T_j=150°C$		
							$R_{th\,j-a}=0.5°C/mW$		
BCY33	$h_{FE}<35$	-20	-4.5	$-I_{CBO}<50$ nA	0	-6	$-I_{CM}=100$ mA	length <6.6	
p-n-p	$f_T=1.5$ MHz	-1	-6	$C_c<60$ pF	0	-6	$-V_{CEO}=25$ V	width <9.4	
switch	$h_{fe}<35$	-1	-6				$P_{tot}=250$ mW	leads >38	
general	$F<20$ dB	-0.5	-2				$T_j=150°C$		
							$R_{th\,j-a}=0.5°C/mW$		

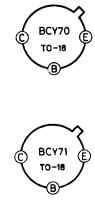
LOW FREQUENCY TRANSISTORS

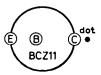
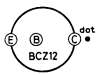
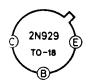
Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
BCY34	h_{FE} < 60	−20	−4.5	$-I_{CBO}$ < 50 nA	0	−6	$-I_{CM}$ = 100 mA	length < 6.6
p-n-p	f_T = 2.4 MHz	−1	−6	C_c < 60 pF	0	−6	$-V_{CEO}$ = 25 V	width < 9.4
switch	h_{fe} < 60	−1	−6	F < 20 dB	0.5	−2	P_{tot} = 250 mW	leads > 38
general	F < 20 dB	−0,5	−2				T_j = 150°C	
							$R_{th\,j-a}$ = 0.5°C/mW	
BCY38	h_{FE} < 30	−150	−1	$-I_{CBO}$ < 100 nA	0	−6	$-I_{CM}$ = 500 mA	length < 6.6
p-n-p	f_T = 1.5 MHz	−1	−6	C_c < 150 pF	0	−6	$-V_{CEO}$ = 24 V	width < 9.4
switch	h_{fe} < 100	−10	−6				P_{tot} = 410 mW	leads > 38
general	F < 20 dB	−0.5	−2				T_j = 150°C	
							$R_{th\,j-a}$ = 0.3°C/mW	
BCY39	Equivalent to BCY38 except for:						$-V_{CEO}$ = 60 V	
	h_{FE} < 50	−150	−1					
BCY40	h_{FE} < 120	−150	−1	$-I_{CBO}$ < 100 nA	0	−6	$-I_{CM}$ = 500 mA	length < 6.6
p-n-p	f_T = 2.5 MHz	−1	−6	C_c < 150 pF	0	−6	$-V_{CEO}$ = 24 V	width < 9.4
switch	F < 20 dB	−0.5	−2				P_{tot} = 410 mW	leads > 38
general	h_{fe} < 160	−10	−6				T_j = 150°C	
							$R_{th\,j-a}$ = 0.3°C/mW	
BCY54	h_{FE} < 70	−150	−1	$-I_{CBO}$ < 100 nA	0	−6	$-I_{CM}$ = 500 mA	length < 6.6
p-n-p	f_T = 2.0 MHz	−1	−6	C_c < 150 pF	0	−6	$-V_{CEO}$ = 50 V	width < 9.4
switch	F < 20 dB	−0.5	−2				P_{tot} = 410 mW	leads > 38
general	h_{FE} < 120	−10	−6				T_j = 150°C	
							$R_{th\,j-a}$ = 0.3°C/mW	

BCY56 n-p-n general	$h_{FE} > 40$ $h_{FE} < 450$ $f_T = 350$ MHz $F < 5$ dB $h_{ie} = 3500\ \Omega$ $h_{fe} < 500$ $h_{oe} = 17.5\ \mu\Omega^{-1}$	0.01 2 10 0.2 2 2 2	5 5 5 5 5 5 5	$I_{CBO} < 100$ nA $C_c = 4.5$ pF	0 0	20 5	$I_{CM} = 100$ mA $V_{CEO} = 45$ V $P_{tot} = 300$ mW $T_j = 175°C$ $R_{th\,j-a} = 0.5°C/mW$	length < 5.3 width < 4.8 leads > 12.7	
BCY57 n-p-n general	$h_{FE} > 100$ $h_{FE} < 800$ $f_T = 350$ MHz $F < 5$ dB $h_{ie} = 7500\ \Omega$ $h_{fe} < 900$ $h_{oe} = 35\ \mu\Omega^{-1}$	0.01 2 10 0.2 2 2 2	5 5 5 5 5 5 5	$I_{CBO} < 100$ nA $C_c = 4.5$ pF	0 0	20 20	$I_{CM} = 100$ mA $V_{CEO} = 20$ V $P_{tot} = 300$ mW $T_j = 175°C$ $R_{th\,j-a} = 0.5°C/mW$	length < 5.3 width < 4.8 leads > 12.7	
BCY58 **(VII)(VIII)** **(IX)(X)** n-p-n amplifier and switching applications	$V_{BE} = 0.70$ V VII: $h_{FE} = 250$ VIII: $h_{FE} = 300$ IX: $h_{FE} = 390$ X: $h_{FE} = 550$ VII: $h_{fe} = 200$ VIII: $h_{fe} = 260$ IX: $h_{fe} = 330$ X: $h_{fe} = 520$ $f_T = 280$ MHz $F = 2$ dB	10 10 10 10 10 2 2 2 2 10 0.2	1 1 1 1 1 1 1 1 1 5 5	$I_{CBO} < 10\ \mu$A $C_c = 3$ pF	0 0	32 10	$I_C = 200$ mA $V_{CEO} = 32$ V $P_{tot} = 1$ W $T_j = 200°C$ $R_{th\,j-a} = 0.45°C/mW$	length < 5.3 width < 4.8 leads > 12.7	
BCY59 **(VII)(VIII)** **(IX)(X)**	Equivalent to BCY58 except for:			$I_{CBO} < 10\ \mu$A	0	45	$V_{CEO} = 45$ V		

LOW FREQUENCY TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	*Characteristics at:*	I_E (*mA*)	V_{CB} (*V*)	*Ratings*	*Outlines (mm)*
BCY70	$h_{FE} > 45$	−1	−1	$-I_{CBO} < 10$ nA	0	−40	$-I_{CM} = 200$ mA	length < 5.3
p-n-p	$h_{FE} > 15$	−50	−1	$-I_{CBO} < 500$ nA	0	−50	$-V_{CEO} = 40$ V	width < 4.8
general	$f_T > 250$ MHz	−10	−20	$C_c < 6$ pF	0	−10	$P_{tot} = 350$ mW	leads > 12.7
	$F < 6$ dB	−0.1	−5				$T_j = 200°C$	
							$R_{th\,j-a} = 0.5°C/mW$	
BCY71	$h_{FE} > 90$	−1	−1	$-I_{CBO} < 50$ nA	0	−40	$-I_{CM} = 200$ mA	length < 5.3
p-n-p	$h_{FE} > 100$	−10	−1	$-I_{CBO} < 500$ nA	0	−45	$-V_{CEO} = 45$ V	width < 4.8
general	$f_T > 200$ MHz	−10	−20	$C_c < 6$ pF	0	−10	$P_{tot} = 350$ mW	leads > 12.7
	$F < 2$ dB	−0.1	−5				$T_j = 200°C$	
							$R_{th\,j-a} = 0.5°C/mW$	
BCY72	$h_{FE} > 40$	−1	−1	$-I_{CBO} < 50$ nA	0	−20	$-I_{CM} = 200$ mA	length < 5.3
p-n-p	$h_{FE} > 50$	−10	−1	$-I_{CBO} < 500$ nA	0	−25	$-V_{CEO} = 25$ V	width < 4.8
general	$f_T = 200$ MHz	−10	−20	$C_c < 6$ pF	0	−10	$P_{tot} = 350$ mW	leads > 12.7
	$F < 6$ dB	−0.1	−5				$T_j = 200°C$	
							$R_{th\,j-a} = 0.5°C/mW$	
BCZ10	$h_{FE} = 17.5$	−20	−4.5	$-I_{CBO} < 100$ nA	0	−10	$-I_{CM} = 50$ mA	length < 15.7
p-n-p	$C_c < 80$ pF	−1	−6				$-V_{CEO} = 25$ V	width < 6.0
general	$f_{hfb} = 1$ MHz	−1	−6				$P_{tot} = 250$ mW	leads > 37
	$F = 8.0$ dB	−0.5	−2				$T_j = 150°C$	
	$h_{fc} < 60$	−1	−6				$R_{th\,j-a} = 0.5°C/mW$	



BCZ11	$h_{FE}=29$	-20	-4.5	$-I_{CBO}<100$ nA	0	-10	$-I_{CM}=50$ mA	length <15.7	
p-n-p	$C_c<80$ pF	-1	-6				$-V_{CEO}=25$ V	width <6.0	
general	$f_{hfb}=1.5$ MHz	-1	-6				$P_{tot}=250$ mW	leads >37	
	$F=6.0$ dB	0.5	-2				$T_j=150°C$		
	$h_{fe}<60$	-1	-6				$R_{th\,j-a}=0.5°C/mW$		
BCZ12	$C_c<80$ pF	-1	-6	$-I_{CBO}<100$ nA	0	-10	$-I_{CM}=50$ mA	length <15.7	
p-n-p	$f_{hfb}=1$ MHz	-1	-6				$-V_{CEO}=60$ V	width <6.0	
general	$F=8$ dB	0.5	-2				$P_{tot}=250$ mW	leads >37	
	$h_{fe}=15$	-1	-6				$T_j=150°C$		
							$R_{th\,j-a}=0.5°C/mW$		
2N929	$h_{FE}>60$	0.5	5	$I_{CBO}<10$ nA	0	45	$I_{CM}=60$ mA	length <5.3	
n-p-n	$h_{FE}>100$	10	5	$-V_{EB}<0.8$ V	-0.5	5	$V_{CEO}=45$ V	width <4.8	
general	$f_T>50$ MHz	0.5	5	$C_c<8$ pF	0	5	$P_{tot}=300$ mW	leads >12.7	
	$f_{hfe}>0.2$ MHz	0.5	5				$T_j=175°C$		
	$F<4$ dB	0.01	5				$R_{th\,j-a}=0.5°C/mW$		
	$h_{fe}=200$	1	5						
2N930	$h_{FE}>150$	0.5	5	$I_{CBO}<10$ nA	0	45	$I_{CM}=60$ mA	length <5.3	
n-p-n	$h_{FE}>150$	10	5	$-V_{EB}<0.8$ V	-0.5	5	$V_{CEO}=45$ V	width <4.8	
general	$f_T>50$ MHz	0.5	5	$C_c<8$ pF	0	5	$P_{tot}=300$ mW	leads >12.7	
	$f_{hfe}>0.1$ MHz	0.5	5				$T_j=175°C$		
	$F<3$ dB	0.01	5				$R_{th\,j-a}=0.5°C/mW$		
	$h_{fe}=350$	1	5						

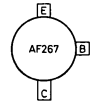
HIGH FREQUENCY TRANSISTORS

Type and applications	*Characteristics at:*	I_C *(mA)*	V_{CE} *(V)*	*Characteristics at:*	I_E *(mA)*	V_{CB} *(V)*	*Ratings*	*Outlines (mm)*
AF121	h_{FE} = 75	−3	−10	$-I_{CBO}$ < 8 μA	0	−10	$-I_{CM}$ = 15 mA	length < 9
p-n-p	$-C_{re}$ < 0.65 pF	−1	−10	F < 6 dB	2	−5	$-V_{CER}$ = 25 V	width < 4.8
tuners	f_T = 270 MHz	−3	−10				P_{tot} = 140 mW	leads > 12.7
	$\|y_{fe}\|$ = 80 mA/V	−3	−10				T_j = 75°C	
							$R_{th\,j-a}$ = 0.45°C/mW	
AF124	$-V_{BE}$ < 330 mV	−1	−6	$-I_{CBO}$ < 8 μA	0	−6	$-I_C$ = 10 mA	length < 5.3
p-n-p	$-C_{re}$ = 1.5 pF	−1	−6	h_{FE} = 140	1	−6	$-V_{CEO}$ = 15 V	width < 4.8
f.m.	h_{fe} = 150	−1	−6	f_T = 75 MHz	1	−6	P_{tot} = 60 mW	leads > 12.7
				F < 9.5 dB	1	−6	T_j = 75°C	
				$\|y_{fb}\|$ = 16 mΩ^{-1}	1	−6	$R_{th\,j-a}$ = 0.75°C/mW	
				G_p = 14 dB	1	−6		
AF125	$-V_{BE}$ < 330 mV	−1	−6	$-I_{CBO}$ < 8 μA	0	−6	$-I_C$ 10 mA	length < 5.3
p-n-p	$-C_{re}$ = 1.5 pF	−1	−6	h_{FE} = 140	1	−6	$-V_{CEO}$ = 15 V	width < 4.8
r.f.	h_{fe} = 150	−1	−6	f_T = 75 MHz	1	−6	P_{tot} = 60 mW	leads > 12.7
	$\|y_{fe}\|$ = 34 mA/V	−1	−6	F = 3 dB	1	−6	T_j = 75°C	
	$\|y_{re}\|$ = 0.08 mA/V	−1	−6	F_c < 5 dB	1	−6	$R_{th\,j-a}$ = 0.75°C/mW	
				$\|y_{fb}\|$ = 15 mΩ^{-1}	1	−6		
				G_p = 13 dB	1	−6		
AF126	$-C_{re}$ = 1.5 pF	−1	−6	$-I_{CBO}$ < 8 μA	0	−6	$-I_C$ = 10 mA	length < 5.3
p-n-p	h_{fe} = 150	−1	−6	h_{FE} = 140	1	−6	$-V_{CEO}$ = 15 V	width < 4.8
i.f.	$\|y_{fe}\|$ = 32 mA/V	−1	−6	f_T = 75 MHz	1	−6	P_{tot} = 60 mW	leads > 12.7
				F 4.5 dB	1	−6	T_j = 75°C	
				F_c < 5 dB	1	−6	$R_{th\,j-a}$ = 0.75°C/mW	
				G_p = 25 dB	1	−6		

AF127	$-V_{BE}<330$ mV	-1	-6	$-I_{CBO}<8$ μA	0	-6	$-I_C=10$ mA	length <5.3	
p-n-p	$-C_{re}=1.5$ pF	-1	-6	$h_{FE}=140$	1	-6	$-V_{CEO}=15$ V	width <4.8	
i.f.	$\|y_{fe}\|=37$ mA/V	-1	-6	$f_T=75$ MHz	1	-6	$P_{tot}=60$ mW	leads >12.7	
r.f.				$F<3$ dB	1	-6	$T_j=75$°C		
				$F_c<5$ dB	1	-6	$R_{th\,j-a}=0.75$°C/mW		
				$G_p=42$ dB	1	-6			
AF139	$-C_{re}=0.25$ pF	-1.5	-12	$-I_{CBO}<8$ μA	0	-20	$-I_{CM}=10$ mA	length <5.3	
p-n-p	$f_T=550$ MHz	-1.5	-12	$h_{FE}=55$	2	-6	$-V_{CEO}=15$ V	width <4.8	
pre-ampl.				$F<8.2$ dB	1.5	-12	$P_{tot}=60$ mW	leads >12.7	
mixer-				$\|y_{fb}\|=37$ mΩ^{-1}	1.5	-12	$T_j=90$°C		
oscill.				$G_{UM}=11.5$ dB	1.5	-12	$R_{th\,j-a}=0.75$°C/mW		
				$G_{tr}=11$ dB	1.5	-12			
				$G_{tr\,rev}=-23$ dB	1.5	-12			
AF239	$-C_{re}=0.23$ pF	-2	-10	$-I_{CBO}<8$ μA	0	-20	$-I_{CM}=15$ mA	length <5.3	
p-n-p	$f_T=650$ MHz	-2	-10	$V_{EB}=350$ mV	2	-10	$-V_{CEO}=15$ V	width <4.8	
tuner				$h_{FE}=33$	2	-10	$P_{tot}=60$ mW	leads >12.7	
				$F<6$ dB	2	-10	$T_j=90$°C		
				$\|y_{fb}\|=20$ mΩ^{-1}	2	-10	$R_{th\,j-a}=0.75$°C/mW		
				$G_{UM}=17$ dB	2	-10			
				$G_{tr}=14$ dB	2	-10			
AF239S	$-C_{re}=200$ fF	-2	-10	$-I_{CBO}<60$ μA	0	-20	$-I_{CM}=15$ mA	length <5.3	
p-n-p	$f_T=780$ MHz	-2	-10	$V_{EB}=400$ mV	5	-5	$-V_{CEO}=15$ V	width <4.8	
pre-ampl.				$F<6$ dB	-2	-10	$P_{tot}=60$ mW	leads >12.7	
mixer				$G_{tr}=15$ dB	-2	-10	$T_j=90$°C		
							$R_{th\,j-a}=0{,}75$°C/mW		

HIGH FREQUENCY TRANSISTORS

Type and applications	*Characteristics at:*	I_C *(mA)*	V_{CE} *(V)*	*Characteristics at:*	I_E *(mA)*	V_{CB} *(V)*	*Ratings*	*Outlines (mm)*
AF240	$-V_{BE}=370$ mV	-2	-10	$-I_{CBO}<8$ μA	0	-10	$-I_{CM}=10$ mA	length <5.3
p-n-p	$h_{FE}=25$	-2	-10	$F=5.5$ dB	2	-10	$-V_{CEO}=15$ V	width <4.8
tuner	$-C_{re}=0.26$ pF	-1	-10	$G_{tr}=14$ dB	2	-10	$P_{tot}=60$ mW	leads >12.7
	$f_T=650$ MHz	-2	-10				$T_j=90°C$	
							$R_{th\,j-a}=0.75°C/mW$	
AF267	$-V_{BE}=350$ mV	-2	-10				$-I_C=10$ mA	diameter <4.8
p-n-p	$h_{FE}>10$	-2	-10				$-V_{CEO}=15$ V	height <2.7
pre-ampl	$h_{FE}>10$	-10	-2				$P_{tot}=60$ mW	leads >7
mixer	$-C_{re}=400$ fF	-2	-10				$T_j=90°C$	
	$f_T=780$ MHz	-2	-10				$R_{th\,j-a}=0.6°C/mW$	
	$F<6$ dB	-2	-10					
	$G_{tr}=12$ dB	-2	-10					
AFY16	$-C_{re}=0.25$ pF	-1.5	-12	$-I_{CBO}<3$ μA	0	-20	$-I_{CM}=8$ mA	length <5.3
p-n-p	$f_T=550$ MHz	-1.5	-12	$h_{FE}=60$	1.5	-12	$-V_{CEO}=25$ V	width <4.8
pre-ampl.				$F<8$ dB	1.5	-12	$P_{tot}=60$ mW	leads >12.7
				$\lvert y_{fb}\rvert=14$ mΩ^{-1}	1.5	-12	$T_j=90°C$	
				$G_{UM}=11.5$ dB	1.5	-12	$R_{th\,j-a}=0.75°C/mW$	
				$G_{tr}=11$ dB	1.5	-12		
				$G_{tr\,rev}=-23$ dB	1.5	-12		



BF115
n-p-n
general

h_{FE}	<165	1	10
h_{FE}	>40	20	2
$-C_{re}$	$=0.65$ pF	1	10
f_T	$=230$ MHz	1	10
F	$=3.5$ dB	1	10
F_c	$=2.5$ dB	1	10
$\lvert y_{fe}\rvert$	$=30$ mA/V	1	10
$-V_{EB}$	<740 mV	-1	10
$\lvert y_{fb}\rvert$	$=30$ mΩ^{-1}	-1	10

$I_{CM} = 30$ mA
$V_{CEO} = 30$ V
$P_{tot} = 145$ mW
$T_j = 175$°C
$R_{th\,j-a} = 0.9$°C/mW

length <5.3
width <4.8
leads >12.7

BF167
n-p-n
gain-control
video

V_{BE}	$=0.7$ V	4	10
h_{FE}	$=57$	4	10
$-C_{re}$	$=0.15$ pF	1	10
f_T	$=350$ MHz	4	10
F	$=3$ dB	4	10
$\lvert y_{fe}\rvert$	≥ 95 mA/V	4	10
G_{UM}	$=42$ dB	4	10
G_{tr}	$=26$ dB	4	10
ΔG_{tr}	$=60$ dB	4	10

$I_{CM} = 25$ mA
$V_{CEO} = 30$ V
$P_{tot} = 130$ mW
$T_j = 175$°C
$R_{th\,j-a} = 1.0$°C/mW

length <5.3
width <4.8
leads >12.7

BF173
n-p-n
video
output

h_{FE}	$=85$	7	10
$-C_{re}$	$=0.23$ pF	1	10
f_T	$=550$ MHz	5	10
$\lvert y_{fe}\rvert$	$=145$ mA/V	7	10
G_{UM}	$=42.5$	7	10
G_{tr}	$=26$	7.2	16.6

$I_{CM} = 25$ mA
$V_{CEO} = 25$ V
$P_{tot} = 260$ mW
$T_j = 175$°C
$R_{th\,j-a} = 0.65$°C/mW

length <5.3
width <4.8
leads >12.7

BF177
n-p-n
t.v.

V_{BE}	<1.2 V	15	10
h_{FE}	>20	15	10
$-C_{re}$	<3.5 pF	10	20
f_T	$=120$ MHz	10	10

$I_{CM} = 50$ mA
$V_{CEO} = 60$ V
$P_{tot} = 600$ mW
$T_j = 200$°C
$R_{th\,j-a} = 220$°C/mW

length <6.6
width <8.5
leads >38.1

HIGH FREQUENCY TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
BF178	V_{BE} <1.2 V	20	15				I_{CM} = 50 mA	length < 6.6
	h_{FE} >20	20	15				V_{CEO} = 115 V	width < 8.5
	$-C_{re}$ <3.5 pF	10	20				P_{tot} = 600 mW	leads > 38.1
	f_T = 120 MHz	10	10				T_j = 200°C	
							$R_{th\,j-a}$ = 220°C/mW	
BF179	V_{BE} <1.2 V	20	15				I_{CM} = 50 mA	length < 6.6
	h_{FE} >20	20	15				V_{CEO} = 115 V	width < 8.5
	$-C_{re}$ <3.5 pF	10	20				P_{tot} = 600 mW	leads > 38.1
	f_T = 120 MHz	10	10				T_j = 200°C	
BF180	$-C_{re}$ = 0.28 pF	1	10	h_{FE} = 45	−2	10	I_{CM} = 20 mA	length < 5.3
n-p-n	f_T = 675 MHz	2	10	F = 4.5 dB	−2	10	V_{CEO} = 20 V	width < 4.8
television				G_{UM} = 24 dB	−2	10	P_{tot} = 150 mW	leads > 12.7
tuner				G_{tr} = 16.5 dB	−2	10	T_j = 175°C	
							$R_{th\,j-a}$ = 1°C/mW	
BF181	$-C_{re}$ = 0.28 pF	1	10	h_{FE} = 28.5	−2	10	I_{CM} = 20 mA	length < 5.3
n-p-n	f_T = 600 MHz	2	10	$\lvert y_{fb}\rvert$ = 25 mΩ^{-1}	−2	10	V_{CEO} = 20 V	width < 4.8
u.h.f.				G_{UM} = 11 dB	−2	10	P_{tot} = 150 mW	leads > 12.7
				G_{tr} = 8 dB	−2	10	T_j = 175°C	
							$R_{th\,j-a}$ = 1°C/mW	

BF182	$-C_{re}$ = 0.33 pF	1	10	$-V_{EB}$ = 770 mV	−2	10	I_{CM} = 15 mA	length < 5.3 •	
n-p-n	f_T = 650 MHz	2	10	h_{FE} = 20	−2	10	V_{CEO} = 20 V	width < 4.8	
integrated				F = 7.4 dB	−2	10	P_{tot} = 150 mW	leads > 12.7	
tuner				$\|y_{fb}\|$ = 18 mΩ^{-1}	−2	10	T_j = 175°C		
				$\|y_{rb}\|$ = 1.3 mΩ^{-1}	−2	10	$R_{th\,j-a}$ = 1°C/mW		
				G_{UM} = 11 dB	−2	10			
				G_{tr} = 10 dB	−2	10			
BF183	$-C_{re}$ = 0.33 pF	1	10	h_{FE} = 25	−3	10	I_{CM} = 15 mA	length < 5.3	
n-p-n	f_T = 800 MHz	3	10	$\|y_{fb}\|$ = 18 mΩ^{-1}	−3	10	V_{CEO} = 20 V	width < 4.8	
integrated				G_{UM} = 13 dB	−3	10	P_{tot} = 150 mW	leads > 12.7	
tuner				G_{tr} = 12 dB	−3	10	T_j = 175°C		
							$R_{th\,j-a}$ = 1°C/mW		
BF184	V_{BE} < 740 mV	1	10				I_{CM} = 30 mA	length < 5.3	
n-p-n	h_{FE} = 115	1	10				V_{CEO} = 20 V	width < 4.8	
i.f.	$-C_{re}$ = 0.65 pF	1	10				P_{tot} = 145 mW	leads > 12.7	
	f_T = 300 MHz	1	10				T_j = 175°C		
	F_c = 3 dB	1	10				$R_{th\,j-a}$ = 0.9°C/mW		
	$\|y_{fe}\|$ = 35 mA/V	1	10						
BF185	V_{BE} < 740 mV	1	10	$\|y_{fb}\|$ = 33 mA/V	−1	10	I_{CM} = 30 mA	length < 5.3	
n-p-n	h_{FE} = 67	1	10				V_{CEO} = 20 V	width < 4.8	
pre-ampl.	$-C_{re}$ = 0.65 pF	1	10				P_{tot} = 145 mW	leads > 12.7	
	f_T = 220 MHz	1	10				T_j = 175°C		
	F = 4 dB	1	10				$R_{th\,j-a}$ = 0.9°C/mW		
BF194	h_{FE} = 115	1	10				I_{CM} = 30 mA	length < 7.6	
n-p-n	$-C_{re}$ = 0.95 pF	1	10				V_{CEO} = 20 V	width < 4.6	
radio	f_T = 260 MHz	1	10				P_{tot} = 250 mW	height < 5.1	
television	F = 1.2 dB	1	10				T_j = 125°C	lock-fit	
	F_c = 2 dB	1	10				$R_{th\,j-a}$ = 0.40°C/mW		
	$\|y_{fe}\|$ = 33 mA/V	1	10						

BF194

HIGH FREQUENCY TRANSISTORS

Type and applications	*Characteristics at:*	I_C *(mA)*	V_{CE} *(V)*	*Characteristics at:*	I_E *(mA)*	V_{CB} *(V)*	*Ratings*	*Outlines (mm)*
BF195	h_{FE} = 67	1	10				I_{CM} = 30 mA	length < 7.6
n-p-n	$-C_{re}$ = 0.95 pF	1	10				V_{CEO} = 20 V	width < 4.6
radio	f_T = 200 MHz	1	10				P_{tot} = 250 mW	height < 5.1
television	F = 4 dB	1	10				T_j = 125°C	lock-fit
	F_c = 2.5 dB	1	10				$R_{th\,j-a}$ = 0.40°C/mW	
	$\|y_{fb}\|$ = 34 mA/V	1	10					
BF196	V_{BE} < 840 mV	4	10				I_{CM} = 25 mA	length < 7.6
n-p-n	h_{FE} > 20	6	2				V_{CEO} = 30 V	width < 4.6
gain-control	h_{FE} > 10	15	5				P_{tot} = 250 mW	height < 5.1
video	$-C_{re}$ = 0.2 pF	1	10				T_j = 125°C	lock-fit
	f_T = 400 MHz	4	10				$R_{th\,j-a}$ = 0.4°C/mW	
	F = 3 dB	4	10					
	$\|y_{fe}\|$ = 100 mA/V	4	10					
	G_{UM} = 40 dB	4	10					
	G_{tr} = 25.5 dB	4	a.g.c.					
	ΔG_{tr} = 60 dB	4	a.g.c.					
BF197	V_{BE} < 0.9 V	7	10				I_{CM} = 25 mA	length < 7.6
n-p-n	h_{FE} > 38	7	10				V_{CEO} = 25 V	width < 4.6
video	$-C_{re}$ = 0.3 pF	1	10				P_{tot} = 250 mW	leads > 5.1
output	f_T = 550 MHz	5	10				T_j = 125°C	lock-fit
	$\|y_{fe}\|$ = 170 mA/V	7	10				$R_{th\,j-a}$ = 0.4°C/mW	
	G_{UM} = 43 dB	7	10					

BF195

BF196

BF197

BF198	V_{BE}	<850 mV	4	10					I_{CM}	$=25$ mA	length <5.2
n-p-n	$-C_{re}$	$=200$ fF	1	10					V_{CEO}	$=30$ V	width <4.8
i.f. ampl.	f_T	$=400$ MHz	4	10					P_{tot}	$=500$ mW	leads >12.7
television	F	$=3$ dB	4	10					T_j	$=150°C$	
	$\|y_{fe}\|$	$=105$ mA/V	4	10					$R_{th\,j-a}$	$=0.25°C/W$	
	G_{UM}	$=42$ dB	4	10							

BF199	V_{BE}	<925 mV	7	10					I_{CM}	$=25$ mA	length <5.2
n-p-n	$-C_{re}$	$=300$ fF	1	10					V_{CEO}	$=25$ V	width <4.8
video i.f.	f_T	$=550$ MHz	5	10					P_{tot}	$=500$ mW	leads >12.7
amplifier	$\|y_{fe}\|$	$=170$ mA/V	7	10					T_j	$=150°C$	
television	G_{UM}	$=43$ dB	7	10					$R_{th\,j-a}$	$=0.25°C/mW$	

BF200	$-C_{re}$	$=0.28$ pF	1	10	h_{FE}	$=30$	-3	10	I_{CM}	$=20$ mA	length <5.3
n-p-n	$\|y_{fe}\|$	$=56$ mA/V	2	10	f_T	$=650$ MHz	-3	10	V_{CEO}	$=20$ V	width <4.8
gain-control					F	$=2.7$ dB	-3	10	P_{tot}	$=150$ mW	leads >12.7
tuner					$\|y_{fb}\|$	$=70$ mΩ^{-1}	-3	10	T_j	$=175°C$	
					G_{UM}	$=22$ dB	-3	10	$R_{th\,j-a}$	$=1°C/mW$	
					G_{UM}	$=28$ dB	-2	10			
					G_{tr}	$=3$ dB	-3	a.g.c.			

BF254	V_{BE}	<0.74 V	1	10					I_{CM}	$=30$ mA	length <5.2
n-p-n	h_{FE}	<140	10	10					V_{CEO}	$=20$ V	width <5.2
f.m. tuners	$-C_{re}$	$=0.85$ pF	1	10					P_{tot}	$=300$ mW	leads >12.7
mixer	f_T	$=260$ MHz	1	10					T_j	$=125°C$	
	F	$=1.5$ dB	1	10					$R_{th\,j-a}$	$=0.33°C/mW$	
	F_c	$=3$ dB	1	10							
	$\|y_{fb}\|$	$=33$ mA/V	1	10							

HIGH FREQUENCY TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
BF255	V_{BE} <0.74 V	1	10				I_{CM} =30 mA	length <5.2
n-p-n	h_{FE} =87	10	10				V_{CEO} =20 V	width <5.2
f.m. tuners	$-C_{re}$ =0.85 pF	1	10				P_{tot} =300 mW	leads >12.7
i.f. ampl.	f_T =200 MHz	1	10				T_j =125°C	
input	F =3.5 dB	1	10				$R_{th\,j-a}$ =0.33°C/mW	
	F_c =4 dB	1	10					
	$\|y_{fb}\|$ =34 mA/V	1	10					
BF257	V_{BE} =<0,7 V	30	10	I_{CBO} <50 nA	0	100	I_{CM} =200 mA	length < 6,6
n-p-n	h_{FE} =>25	30	10	$-C_{re}$ =3,5 pF	0	30	V_{CEO} =160 V	diam < 19,4
video	f_T =90 MHz	15	10				P_{tot} = 5 W	leads >12,7
amplifier							T_j =175°C	
							$R_{th\,j-a}$ =220°C/W	
BF258	Equivalent to BF257 except for:			I_{CBO} < 50 nA	0	200	V_{CEO} =250 V	
BF259	Equivalent to BF257 except for:			I_{CBO} < 50 nA	0	250	V_{CEO} =300 V	
BF334	V_{BE} =0.75 V	1	10	I_{CBO} <50 nA	0	20	I_C =25 mA	length <7.6
n-p-n	h_{FE} >65	1	10	I_{CBO} <10 μA	0	40	V_{CEO} =30 V	width <4.6
a.m. mixers	h_{FE} <220	1	10				P_{tot} =250 mW	height <5.1
i.f. ampl.	$-C_{re}$ <0.3 pF	1	10				T_j =125°C	lock-fit
in a.m./f.m.	f_T =430 MHz	1	10				$R_{th\,j-a}$ =0.4°C/mW	
receivers	F =1.5 dB	1	10					
	$\|y_{fe}\|$ =36 mA/V	1	10					

BF335	V_{BE} = 0.75 V	1	10	I_{CBO} < 50 nA	0	20	I_C = 25 mA	length < 7.6
n-p-n	h_{FE} > 35	1	10	I_{CBO} < 10 μA	0	40	V_{CEO} = 30 V	width < 4.6
a.m. mixers	h_{FE} < 125	1	10				P_{tot} = 250 mW	height < 5.1
i.f. ampl.	$-C_{re}$ < 0.3 pF	1	10				T_j = 125°C	lock-fit
in a.m./f.m.	f_T = 370 MHz	1	10				$R_{th\,j-a}$ = 0.4°C/mW	
receivers	F = 2 dB	1	10					
	$\lvert y_{fe}\rvert$ = 36 mA/V	1	10					

BF336	V_{BE} < 1.2 V	30	10	$r_{bb'}C_{b'c}$ < 100 ps	30	20	I_{CM} = 200 mA	length < 6.6
n-p-n	h_{FE} > 20	30	10				V_{CEO} = 180	width < 8.5
video ampl.	h_{FE} = 60	30	10				P_{tot} = 3 W	leads > 12.7
black-and-	$-C_{re}$ = 3.5 pF	10	20				T_j = 200°C	
white	f_T = 130 MHz	30	20				$R_{th\,j-a}$ = 220°C/W	
colour								
television								

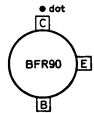
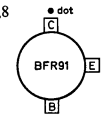
BF337	Equivalent to BF336 except for:						V_{CEO} = 200 V	

BF338	Equivalent to BF336 except for:						V_{CEO} = 225 V	

BF494	V_{BE} < 0,74 V	1	10				I_{CM} = 30 mA	length < 5,2
n-p-n	h_{FE} = 115	10	1				V_{CEO} = 20 V	width < 4,8
f.m. tuner	$-C_{ne}$ = 0,85 pF	1	10				P_{tot} = 300 mW	leads > 12,7
a.m. mixer-osc.	f_T = 260 MHz	1	10				T_j = 125°C	
i.f. ampl.	F = 1,5 dB	1	10				$R_{th\,j-a}$ = 0,25°C/mW	
	F_c = 3 dB	1	10					
	$\lvert y_{fb}\rvert$ = 33 mA/V	1	10					

HIGH FREQUENCY TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
BF495	V_{BE} < 0,74 V	1	10				I_{CM} = 30 mA	length < 5,2
n-p-n	h_{FE} = 87	10	1				V_{CEO} = 20 V	width < 4,8
f.m. tuner	$-C_{re}$ = 0,85 pF	1	10				P_{tot} = 300 mW	leads > 12,7
a.m. input	f_T = 200 MHz	1	10				T_j = 125°C	
i.f. ampl.	F = 3,5 dB	1	10				$R_{th\,j-a}$ = 0,25°C/mW	
	F_c = 4 dB	1	10					
	$\|y_{fb}\|$ = 34 mA/V	1	10					
BFR63	h_{FE} > 25	50	5	I_{CBO} < 10 μA	0	20	I_{CM} = 500 mA	diameter < 9.7
n-p-n	h_{FE} > 25	150	5	C_e < 4.5 pF	0	20	V_{CEO} = 25 V	height < 5.75
band I, II	$-C_{re}$ = 1.7 pF	10	20				P_{tot} = 3.5 W	leads > □25
III and IV	f_T > 1000 MHz	75	20				T_j = 150°C	stud. length = 11.2
vert. defl.	f_T = 1100 MHz	150	20				$R_{th\,j-mb}$ = 25°C/W	stud: 8–32 UNC
oscilloscope	P_o = 150 mW	70	20					
oscillator	G_p = 16 dB	70	20					
BFR64	Equivalent to BFR63 except for:							
	f_T = 1000 MHz	15	20					
	f_T = 1200 MHz	150	20					
BFR65	h_{FE} > 30	200	20	C_c < 10 pF	0	20	I_C = 400 mA	diameter < 9.7
n-p-n	h_{FE} > 20	400	20				I_{CM} = 1000 mA	height < 5.75
high power	$-C_{re}$ = 3.5 pF	10	20				V_{CEO} = 25 V	leads > □25
gain	f_T > 1200 MHz	200	20				P_{tot} = 5 W	stud: length = 11.2
acrial ampl.	f_T > 1000 MHz	400	20				T_j = 200° C	stud: 8–32 UNC
	P_O = 450 mW	200	20				$R_{th\,j-mb}$ = 15° C/W	
	G_p = 19 dB	200	20					

BFR90	h_{FE} >25	14	10	I_{CBO} < 50 nA	0	10	I_C = 25 mA	diameter < 4,8	
n-p-n	f_T = 5 GHz	14	10	C_c = 0,5 pF	0	10	V_{CEO} = 15 V	height < 2,7	
aerial ampl.	$-C_{re}$ = 0,4 pF	2	10				P_{tot} = 180 mW	leads > 3,85	
	F = 2,4 dB	2	10				T_j = 150°C		
	$G_{tr(um)}$ = 19,5 dB	14	10				$R_{th\,j-a}$ = 0,5°C/W		
	d_{im} = − 60 dB	14	10						
BFR91	h_{FE} >25	30	5	I_{CBO} < 50 nA	0	15	I_C = 35 mA	diameter < 4,8	
n-p-n	f_T = 5 GHz	30	5	C_c = 0,7 pF	0	10	V_{CEO} = 12 V	height < 2,7	
aerial ampl.	$-C_{re}$ = 0,8 pF	2	5				P_{tot} = 180 mW	leads > 3,85	
	F = 1,9 dB	2	5				T_j = 150°C		
	$G_{tr(um)}$ = 16,5 dB	30	5				$R_{th\,j-a}$ = 0,5°C/mW		
	d_{im} = − 60 dB	30	5						
BFS92	h_{FE} > 20	− 10	− 10	$-I_{CBO}$ < 50 nA	0	− 80	$-I_{CM}$ = 1 A	length < 6.6	
p-n-p	h_{FE} > 30	− 150	− 10	C_c < 20 pF	0	− 10	$-V_{CEO}$ = 60 V	width < 8.5	
general	h_{FE} > 20	− 500	− 10	t_d = 20 ns			P_{tot} = 5 W	leads > 12.7	
industrial	h_{FE} > 15	− 1000	− 10	t_r = 35 ns			T_j = 200°C		
	f_T = 70 MHz	− 50	− 10	t_s = 500 ns			$R_{th\,j-a}$ = 220°C/W		
	h_{fe} = 100	− 10	− 5	t_f = 65 ns					
BFS93	h_{FE} > 50	− 10	− 10	$-I_{CBO}$ < 50 nA	0	− 80	$-I_{CM}$ = 1 A	length < 6.6	
p-n-p	h_{FE} > 70	− 150	− 10	C_c < 20 pF	0	− 10	$-V_{CEO}$ = 60 V	width < 8.5	
general	h_{FE} > 30	− 500	− 10	t_d = 20 ns			P_{tot} = 5 W	leads > 12.7	
industrial	h_{FE} > 15	− 1000	− 10	t_r = 35 ns			T_j = 200°C		
	f_T = 70 MHz	− 50	− 10	t_s = 500 ns			$R_{th\,j-a}$ = 220°C/W		
	h_{fe} = 100	− 10	− 5	t_f = 65 ns					

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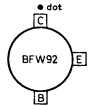
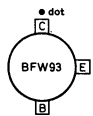
Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
BFS94	$h_{FE} > 30$	−10	−10	$-I_{CBO} < 50$ nA	0	−60	$-I_{CM} = 1$ A	length < 6.6
p-n-p	$h_{FE} > 40$	−150	−10	C_c < 20 pF	0	−10	$-V_{CEO} = 40$ V	width < 8.5
general	$h_{FE} > 25$	−500	−10	t_d = 20 ns			P_{tot} = 5 W	leads > 12.7
industrial	$h_{FE} > 15$	−1000	−10	t_r = 35 ns			T_j = 200°C	
	f_T = 70 MHz	−50	−10	t_s = 500 ns			$R_{th\,j-a}$ = 220°C/W	
	$h_{fe} = 100$	−10	−5	t_f = 65 ns				
BFS95	$h_{FE} > 50$	−10	−10	$-I_{CBO} < 50$ nA	0	−30	$-I_{CM} = 1$ A	length < 6.6
p-n-p	$h_{FE} > 70$	−150	−10	C_c < 20 pF	0	−10	$-V_{CEO} = 35$ V	width < 8.5
general	$h_{FE} > 30$	−500	−10	t_d = 20 ns			P_{tot} = 5 W	leads > 12.7
industrial	$h_{FE} > 15$	−1000	−10	t_r = 35 ns			T_j = 200°C	
	f_T = 70 MHz	−50	−10	t_s = 500 ns			$R_{th\,j-a}$ = 220°C/W	
	$h_{fe} = 100$	−10	−5	t_f = 65 ns				
BFW16A	h_{FE} > 25	50	5	$I_{CBO} < 20$ µA	0	20	I_{CM} = 300 mA	length < 6.6
n-p-n	h_{FE} > 25	150	5	C_c < 4 pF	0	15	V_{CEO} = 25 V	width < 8.5
band I to V	f_T = 1,2 GHz	150	15				P_{tot} = 1500 mW	leads > 12.7
vert. ampl.	$-C_{re} = 1.7$ pF	10	15				T_j = 200°C	
oscilloscope	F < 6 dB	30	15				$R_{th\,j-a}$ = 250°C/W	
	G_p = 16 dB	70	18					
	P_o = 150 mW	70	18					
BFW17A	h_{FE} > 25	50	5	$I_{CBO} < 20$ µA	0	20	I_{CM} = 300 mA	length < 6.6
n-p-n	h_{FE} > 25	150	5	C_c < 4 pF	0	15	V_{CEO} = 25 V	width < 8.5
band I to III	f_T = 1.1 GHz	150	15				P_{tot} = 1.5 W	leads > 12.7
	$-C_{re} = 1.7$ pF	10	15				T_j = 200°C	
	G_p = 16 dB	70	18				$R_{th\,j-a}$ = 250°C/W	
	P_o = 150 mW	70	18					

BFW30	h_{FE} >25	25	5	I_{CBO} < 50 nA	0	10	I_{CM} = 100 mA	length < 5.3	
n-p-n	h_{FE} >25	50	5	C_c < 1,5 pF	0	5	V_{CEO} = 10 V	width < 4.8	
wide band	f_T = 1,6 GHz	50	5				P_{tot} = 250 mW	leads > 12.7	
amplifier	$-C_{re}$ = 0.8 pF	2	5				T_j = 200°C		
	F < 5 dB	2	5				$R_{th\,j-a}$ = 0.7°C/mW		
	G_p = 21 dB	30	5						
	d_{im} = −60 dB	30	6						
BFW92	h_{FE} < 150	2	1	I_{CBO} < 50 nA	0	10	I_{CM} = 50 mA	diameter < 4.8	
n-p-n	h_{FE} >20	25	1	C_c = 0.7 pF	0	10	V_{CEO} = 15 V	height < 2.7	
wide-band	f_T = 1 GHz	2	5				P_{tot} = 130 mW	leads > 7	
I to V	f_T = 1.6 GHz	25	5				T_j = 125°C		
	$-C_{re}$ = 0.6 pF	2	5				$R_{th\,j-a}$ = 0.4°C/mW		
	F = 4 dB	2	5						
	G_p = 23 dB	10	10						
	P_o = 8 mW	10	10						
	d_{im} = −45 dB	10	6						
BFW93	h_{FE} >25	25	5	I_{CBO} < 50 nA	0	10	I_{CM} = 100 mA	diameter < 4,8	
n-p-n	h_{FE} >25	50	5	C_c = 0,7 pF	0	5	V_{CEO} = 10 V	height < 2,7	
wide-band	f_T = 1,7 GHz	50	5				P_{tot} = 190 mW	leads > 3,85	
aerial ampl.	$-C_{re}$ = 0,6 pF	2	5				T_j = 150°C		
40-800 MHz	F < 5 dB	2	5				$R_{th\,j-a}$ = 0,4°C/mW		
	$G_{tr(um)}$ = 22 dB	30	5						
	d_{im} = −60 dB	30	5						
BFX44	h_{FE} < 120	10	1	I_{CBO} < 100 nA	0	20	I_{CM} = 250 mA	length < 5.3	
n-p-n	h_{FE} > 20	100	1	C_c < 4 pF	0	5	V_{CEO} = 15 V	width < 4.8	
wide-band	f_T > 500 MHz	10	10				P_{tot} = 360 mW	leads > 12.7	
oscilloscope	f_T > 300 MHz	100	3				T_j = 200°C		
							$R_{th\,j-a}$ = 0.48°C/mW		





HIGH FREQUENCY TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)	
BFX89	$h_{FE} > 20$	25	1	$C_c < 1.7$ pF	0	10	$I_{CM} = 50$ mA	length < 5.3	
n-p-n	$f_T = 1{,}2$ GHz	25	5				$V_{CEO} = 15$ V	width < 4.8	
v.h.f.	$F < 6.5$ dB	2	5				$P_{tot} = 200$ mW	leads > 12.7	
u.h.f.	$P_o = 6$ mW	8	10				$T_j = 200$°C		
	$G_p = 22$ dB	8	10				$R_{th\,j-a} = 0.88$°C/mW		
BFY50	$h_{FE} = 112$	150	10	$I_{CBO} < 50$ nA	0	60	$I_{CM} = 1$ A	length < 6.6	
n-p-n	$f_T = 140$ MHz	50	10	$C_c < 12$ pF	0	10	$V_{CEO} = 35$ V	width < 8.5	
general	$h_{fe} = 90$	10	5				$P_{tot} = 5$ W	leads > 12.7	
	$h_{fe} = 60$	1	5				$T_j = 200$°C		
							$R_{th\,j-a} = 0.22$°C/mW		
BFY51	$h_{FE} = 123$	150	10	$I_{CBO} < 50$ nA	0	40	$I_{CM} = 1$ A	length < 6.6	
n-p-n	$f_T = 160$ MHz	50	10	$C_c < 12$ pF	0	10	$V_{CEO} = 30$ V	width < 8.5	
general	$h_{fe} = 100$	10	5				$P_{tot} = 5$ W	leads > 12.7	
	$h_{fe} = 65$	1	6				$T_j = 200$°C		
							$R_{th\,j-a} = 0.22$°C/mW		
BFY52	$h_{FE} = 142$	150	10	$I_{CBO} < 50$ nA	0	30	$I_{CM} = 1$ A	length < 6.6	
n-p-n	$f_T = 185$ MHz	50	10	$C_c < 12$ pF	0	10	$V_{CEO} = 20$ V	width < 8.5	
general	$h_{fe} = 110$	10	5				$P_{tot} = 5$ W	leads > 12.7	
	$h_{fe} = 70$	1	5				$T_j = 200$°C		
							$R_{th\,j-a} = 0.22$°C/mW		

BFY55	$h_{FE} < 120$	150	10	$I_{CBO} < 10$ nA	0	60	$I_{CM} = 1$ A	length < 6.6	
n-p-n	$f_T > 60$ MHz	50	10	$C_c < 12$ pF	0	10	$V_{CEO} = 35$ V	width < 8.5	
oscillator	$h_{fe} = 52$	10	6				$P_{tot} = 4$ W	leads > 12.7	
	$h_{fe} = 36$	1	6				$T_j = 200$°C		
							$R_{th\,j-a} = 0.22$°C/mW		
BFY90	$h_{FE} < 150$	2	1	$I_{CBO} < 10$ nA	0	15	$I_{CM} = 50$ mA	length < 5.3	
n-p-n	$-C_{re} < 0.8$ pF	2	5	$C_c < 1.5$ pF	0	10	$V_{CEO} = 15$ V	width < 4.8	
general	$f_T > 1000$ MHz	2	5				$P_{tot} = 200$ mW	leads > 12.7	
band I to IV	$F < 5$ dB	2	5				$T_j = 200$°C		
	$\lvert y_{fe} \rvert = 45$ mA/V	2	5				$R_{th\,j-a} = 0.88$°C/mW		
	$G_{UM} = 22$ dB	2	5						
	$P_o = 12$ mW	14	10						
2N918	$f_T > 900$ MHz	6	10	$I_{CBO} < 10$ nA	0	15	$I_C = 50$ mA	length < 5,3	
n-p-n	$F < 6$ dB	1	6	$C_c < 1,7$ pF	0	10	$V_{CEO} = 15$ V	width < 4,8	
low power	$P_o > 30$ mW	8	15	$C_c < 3,0$ pF	0	10	$P_{tot} = 200$ mW	leads > 12,7	
amplifier and	$G_{UM} = 36$ dB	6	12				$T_j = 200$°C		
oscillators	$G_p > 15$ dB	6	–				$R_{th\,j-a} = 0,88$°C/mW		
v.h.f./u.h.f.									
2N1613	$h_{FE} > 20$	0.1	10	$I_{CBO} < 10$ nA	0	60	$I_{CM} = 1$ A	length < 6.6	
n-p-n	$h_{FE} > 40$	150	10	$C_c < 25$ pF	0	10	$V_{CER} = 50$ V	width < 8.5	
general	$h_{FE} > 20$	500	10				$P_{tot} = 3$ W	leads > 12.7	
	$f_T > 60$ MHz	50	10				$T_j = 200$°C		
	$F < 12$ dB	0.3	10				$R_{th\,j-a} = 220$°C/W		
	$h_{fe} < 100$	1	5						
	$h_{fe} < 150$	5	10						

HIGH FREQUENCY TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	Characteristics at:	I_E (mA)	V_{CB} (V)	Ratings	Outlines (mm)
2N1711	$h_{FE} > 35$	0.1	10	$I_{CBO} < 10$ nA	0	60	$I_{CM} = 1$ A	length < 6.6
n-p-n	$h_{FE} > 100$	150	10	$C_c < 25$ pF	0	10	$V_{CER} = 50$ V	width < 8.5
general	$h_{FE} > 40$	500	10				$P_{tot} = 3$ W	leads > 12.7
	$f_T > 70$ MHz	50	10				$T_j = 200°C$	
	$F < 8$ dB	0.3	10				$R_{th\,j-a} = 220°C/W$	
	$h_{fe} < 200$	1	5					
	$h_{fe} < 300$	5	10					
2N1893	$h_{FE} > 35$	10	10	$I_{CBO} < 10$ nA	0	90	$I_C = 500$ mA	length < 6.6
n-p-n	$h_{FE} > 40$	150	10	$C_c < 15$ pF	0	10	$V_{CEO} = 80$ V	width < 8.5
general	$h_{fe} > 45$	5	10				$P_{tot} = 3$ W	leads > 38
	$h_{fe} > 2.5$	50	10				$T_j = 200°C$	
							$R_{th\,j-a} = 219°C/W$	
2N2297	$h_{FE} > 30$	10	10	$I_{CBO} < 10$ nA	0	60	$I_C = 1$ A	length < 6.6
n-p-n	$h_{FE} > 40$	150	10	$C_c < 12$ pF	0	10	$V_{CEO} = 35$ V	width < 8.5
v.h.f.	$h_{FE} > 15$	1000	10				$P_{tot} = 5$ W	leads > 12.7
	$f_T > 60$ MHz	50	10				$T_j = 200°C$	
							$R_{th\,j-a} = 220°C/W$	
2N2483	$h_{FE} > 40$	0.01	5	$I_{CBO} < 10$ nA	0	45	$I_{CM} = 50$ mA	length < 5.3
n-p-n	$h_{FE} > 75$	0.1	5	$C_c < 6$ pF	0	5	$V_{CEO} = 60$ V	width < 4.8
general	$h_{FE} > 175$	1	5				$P_{tot} = 360$ mW	leads > 12.7
	$h_{FE} < 500$	10	5				$T_j = 200°C$	
	$f_T = 80$ MHz	0.5	5				$R_{th\,j-a} = 0.48°C/mW$	
	$F < 4$ dB	0.01	5					
	$h_{fe} > 80$	1	5					

2N2484	$h_{FE} > 100$	0.01	5	$I_{CBO} < 10$ nA	0	45	I_{CM} = 50 mA	length < 5.3	
n-p-n	$h_{FE} > 175$	0.1	5	C_c < 6 pF	0	5	V_{CEO} = 60 V	width < 4.8	
general	$h_{FE} > 250$	1	5				P_{tot} = 360 mW	leads > 12.7	
	$h_{FE} < 800$	10	5				T_j = 200°C		
	f_T = 80 MHz	0.5	5				$R_{th\,j-a}$ = 0.48°C/mW		
	F < 3 dB	0.01	5						
	$h_{fe} > 150$	1	5						
2N3570	$h_{FE} > 20$	5	6	$I_{CBO} < 10$ nA	0	6	I_C = 50 mA	length < 5.3	
n-p-n	f_T > 1500 MHz	5	6	$-C_{re} < 0.75$ pF	0	6	V_{CEO} = 15 V	width < 4.8	
v.h.f.	$h_{fe} > 20$	5	6	F < 7 dB	−2	6	P_{tot} = 200 mW	leads > 12.7	
u.h.f.							T_j = 200°C		
							$R_{th\,j-a}$ = 0.88°C/mW		
2N3571	Equivalent to 2N3570 except for:			$-C_{re} < 0.85$ pF	0	6			
	$f_T > 1200$ MHz	5	6	F < 4 dB	−2	6			
2N3572	Equivalent to 2N3570 except for:			$-C_{re} < 0.85$ pF	0	6	V_{CEO} = 13 V		
	$f_T > 1000$ MHz	5	6	F < 6 dB	−2	6			

POWER TRANSISTORS

Type and applications	*Characteristics at:*	I_C (A)	V_{CE} (V)	*Characteristics at:*	I_E (A)	V_{CB} (V)	*Ratings*	*Outlines (mm)*	
AD149 p-n-p class B push-pull l.f.	$-V_{BE}<1.2$ V f_T =0.5 MHz	−3.5 −0.5	−1 −2	$-I_{CBO}<3$ mA h_{FE} <100 h_{FE} <85 C_c =220 pF	0 −1 −3 0	−50 0 0 −5	$-I_C$ =3.5 A $-V_{CEO}$ =30 V P_{tot} =32.5 W T_j =100°C $R_{th\,j-mb}$=2.0°C/W	length <39.5 width <26.6 height <7.0 leads <13.0	AD149
2-AD149 matched pair	$h_{FE1}/h_{FE2}<1.25$ $h_{FE1}/h_{FE2}<1.25$	−0.3 −3							
AD161 n-p-n class B l.f.	$V_{BE}<1.1$ V $h_{FE}<300$ $h_{FE}<320$ f_T =3 MHz	2 0.05 0.5 0.01	1 1 1 2	$I_{CBO}<500$ μA C_c =150 pF	0 0	32 5	I_{CM} =3 mA V_{CEO} =20 V P_{tot} =4 W T_j =90°C $R_{th\,j-mb}$=4.5°C/W	length <31.4 width <19 height <8.9 leads <10.5	AD161
AD161/AD162 matched pair	$h_{FE1}/h_{FE2}<1.25$	|0.5|	|1|						
AD162 p-n-p class B l.f.	$-V_{BE}<0.85$ V h_{FE} <300 h_{FE} <320 f_T =1.5	−2 −0.05 −0.5 −0.01	−1 −1 −1 −2	$-I_{CBO}<200$ μA C_c =115 pF	0 0	−32 −5	$-I_{CM}$ =3 A $-V_{CEO}$ =20 V P_{tot} =6 W T_j =90°C $R_{th\,j-mb}$=4.5°C/W	length <31.4 width <19 height <8.9 leads <10.5	AD162
2-AD162 matched pair	$h_{FE1}/h_{FE2}<1.25$ $h_{FE1}/h_{FE2}<1.25$	−0.05 −0.5	−1 −1						

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	I_E (mA)	V_{CB} (V)	Characteristics at:	I_C (mA)	I_B (mA)	Ratings	Outlines (mm)
ASZ15	$h_{FE} < 55$	−1 A	−1			$-V_{CE\,sat} < 0.4$ V	−10 A	−1 A	$-I_{CM} = 10$ A	length < 39.5
p-n-p	$h_{FE} < 30$	−6 A	−1			$-V_{BE\,sat} < 1.4$ V	−10 A	−1 A	$-V_{CEO} = 60$ V	width < 26.2
power	$f_T = 0.2$ MHz	−1 A	−5			$t_d < 2\ \mu s$			$P_{tot} = 30$ W	height < 7.0
	$-I_{CBO} < 0.1$ mA			0	−5	$t_r < 25\ \mu s$			$T_j = 90°C$	leads < 13
	$-V_{EB} < 1{,}6$ V			6 A	0	$t_s < 10\ \mu s$			$R_{th\,j-mb} = 1{,}5°C/W$	
	$C_c = 190$ pF			0	−5	$t_f < 20\ \mu s$				
2-ASZ15	$h_{FE1}/h_{FE2} < 1.25$	0.3 A	—							
matched pair	$h_{FE1}/h_{FE2} < 1.25$	6.0 A	—							

ASZ15

ASZ16	$h_{FE} < 130$	−1 A	−1			$-V_{CE\,sat} < 0.4$ V	−10 A	−1 A	$-I_{CM} = 10$ A	length < 39.5
p-n-p	$h_{FE} < 80$	−6 A	−1			$-V_{BE\,sat} < 1.4$ V	−10 A	−1 A	$-V_{CEO} = 32$ V	width < 26.2
power	$f_T = 0.25$ MHz	−1 A	−5			$t_d < 2\ \mu s$			$P_{tot} = 30$ W	height < 7.0
	$-I_{CBO} < 0.1$ mA			0	−5	$t_r < 25\ \mu s$			$T_j = 90°C$	leads < 13
	$-V_{EB} < 1{,}4$ V			6 A	0	$t_s < 10\ \mu s$			$R_{th\,j-mb} = 1{,}5°C/W$	
	$C_c = 190$ pF			0	−5	$t_f < 20\ \mu s$				
2-ASZ16	$h_{FE1}/h_{FE2} < 1.25$	−0.3 A	—							
matched pair	$h_{FE1}/h_{FE2} < 1.25$	−6.0 A	—							

ASZ16

ASZ17	Equivalent to ASZ16 except for:		
	$h_{FE} < 75$	−1 A	−1
	$h_{FE} < 45$	−6 A	−1
	$f_T = 0.22$ MHz	−1 A	−5

ASZ17
ASZ18

ASZ18	Equivalent to ASZ16 except for:		
	$h_{FE} < 110$	−1 A	−1
	$h_{FE} < 65$	−6 A	−1
	$f_T = 0.22$ MHz	−1 A	−5

POWER TRANSISTORS

Type and applications	*Characteristics at:*	I_C *(A)*	V_{CE} *(V)*	*Characteristics at:*	I_E *(A)*	V_{CB} *(V)*	*Ratings*	*Outlines (mm)*
BD115 n-p-n class A a.f.	V_{BE} <1 V h_{FE} >22 h_{FE} =60 f_T =145 MHz $-C_{re}$ =3.5 pF	50 mA 50 mA 50 mA 30 mA 10 mA	100 100 100 100 20	I_{CBO} = 550 μA	0	200	I_{CM} =200 mA V_{CEO} =180 V P_{tot} =6 W T_j =200°C $R_{th\,j-mb}$ =12.5°C/W	length <6.6 width <8.5 leads >12.7
BD124 n-p-n hi-fi output stages	V_{BE} =1 V h_{FE} >25 h_{FE} >35 h_{FE} >25 f_T =120 MHz	2 0.05 0.5 2 0.25	5 5 5 5 5	I_{CBO} = 0.5 μA	0	45	I_{CM} =4 A V_{CEO} =45 V P_{tot} =15 W T_j =175°C $R_{th\,j-mb}$ =7.5°C/W	length <31.4 width <19 height <8.9 leads >9
BD131 n-p-n hi-fi output stages	h_{FE} >40 h_{FE} >20 f_T >60 MHz	0.5 2.0 0.25	12 1.0 5	I_{CBO} <5.0 μA C_c <60 pF	0 0	50 5	I_C =3 A I_{CM} =6 A V_{CEO} =45 V P_{tot} =11 W T_j =125°C $R_{th\,j-mb}$ =6°C/W	length <11.1 width < 7.8 height < 2.8 leads >15.3 TO-126
BD131/BD132 matched pair	h_{FE1}/h_{FE2} >78 h_{FE1}/h_{FE2} >40	|0.5| |2|	|12| |1|					
2-BD131 matched pair	h_{FE1}/h_{FE2} >40	|0.5|	|12|					

BD132 p-n-p hi-fi output stages	$h_{FE} > 40$ $h_{FE} > 20$ f_T > 60 MHz	−0.5 −2.0 −0.25	−12 −1.0 −5	$I_{CBO} < 5.0\ \mu A$	0	−40	$-I_C$ = 3 A $-I_{CM}$ = 6 A $-V_{CEO}$ = 45 V P_{tot} = 11 W T_j = 125°C $R_{th\,j-mb}$ = 6° C/W	length < 11.1 width < 7.8 height < 2.8 leads > 15.3 TO-126	 BD132
BD133 n-p-n general purpose medium power	$h_{FE} > 40$ $h_{FE} > 20$ f_T > 60 MHz	0.5 2.0 0.25	12 1.0 5	$I_{CBO} < 5.0\ \mu A$ C_c < 60 pF	0 0	60 5	I_C = 3 A I_{CM} = 6 A V_{CEO} = 60 V P_{tot} = 11 W T_j = 125°C $R_{th\,j-mb}$ = 6° C/W	length < 11.1 width < 7.8 height < 2.8 leads > 15.3 TO-126	 BD133
BD135 hi-fi ampl. driver	$V_{BE} < 1$ V $h_{FE} > 25$ $h_{FE} < 250$ f_T = 250 MHz	0.5 0.005 0.15 0.05	2 2 2 5	$I_{CBO} < 100$ nA	0	30	I_{CM} = 1.5 A V_{CEO} = 45 V P_{tot} = 8 W T_j = 150°C $R_{th\,j-mb}$ = 10°C/W	length < 11.1 width < 7.8 height < 2.8 leads > 15.3 TO-126	 BD135
BD136 p-n-p hi-fi ampl. driver	$-V_{BE} < 1$ V h_{FE} > 25 h_{FE} < 250 f_T = 75 MHz	−0.5 −0.005 −0.15 −0.05	−2 −2 −2 −5	$-I_{CBO} < 100$ nA	0	−30	$-I_{CM}$ = 1.5 A $-V_{CEO}$ = 45 V P_{tot} = 8 W T_j = 150°C $R_{th\,j-mb}$ = 10°C/W	length < 11.1 width < 7.8 height < 2.8 leads > 15.3 TO-126	 BD136
BD135/BD136 matched pair	$h_{FE1}/h_{FE2} < 1.6$	|0.15|	|2|					

POWER TRANSISTORS

Type and ypplications	*Characteristics at:*	I_C (*A*)	V_{CE} (*V*)	*Characteristics at:*	I_E (*A*)	V_{CB} (*V*)	*Ratings*	*Outlines (mm)*	
BD137	$V_{BE} < 1$ V	0.5	2	$I_{CBO} < 100$ nA	0	30	I_{CM} = 1.5 A	length < 11.1	
n-p-n	$h_{FE} > 25$	0.005	2				V_{CEO} = 60 V	width < 7.8	
hi-fi ampl.	$h_{FE} < 160$	0.15	2				P_{tot} = 8 W	height < 2.8	
driver	f_T = 250 MHz	0.05	2				T_j = 150°C	leads > 15.3	
							$R_{th\,j-mb}$ = 10°C/W	TO-126	BD137
BD138	$-V_{BE} < 1$ V	−0.5	−2	$-I_{CBO} < 100$ nA	0	−30	$-I_{CM}$ = 1.5 A	length < 11.1	
p-n-p	h_{FE} > 25	−0.005	−2				$-V_{CEO}$ = 60 V	width < 7.8	
hi-fi ampl.	h_{FE} < 160	−0.15	−2				P_{tot} = 8 W	height < 2.8	
driver	f_T = 75 MHz	−0.05	−2				T_j = 150°C	leads > 15.3	
							$R_{th\,j-mb}$ = 10°C/W	TO-126	BD138
BD137/BD138 matched pair	$h_{FE1}/h_{FE2} < 1.6$	|0.15|	|2|						
BD139	$V_{BE} < 1$ V	0.5	2	$I_{CBO} < 100$ nA	0	30	I_{CM} = 1.5 A	length < 11.1	
n-p-n	$h_{FE} > 25$	0.005	2				V_{CEO} = 80 V	width < 7.8	
hi-fi ampl.	$h_{FE} < 160$	0.15	2				P_{tot} = 8 W	height < 2.8	
driver	f_T = 250 MHz	0.05	2				T_j = 150°C	leads > 15.3	
							$R_{th\,j-mb}$ = 10°C/W	TO-126	BD139
BD140	$-V_{BE} < 1$ V	−0.5	−2	$-I_{CBO} < 100$ nA	0	−30	$-I_{CM}$ = 1.5 A	length < 11.1	
p-n-p	h_{FE} > 25	−0.005	−2				$-V_{CEO}$ = 80 V	width < 7.8	
hi-fi ampl.	h_{FE} > 160	−0.15	−2				P_{tot} = 8 W	height < 2.8	
driver	f_T = 75 MHz	−0.05	−2				T_j = 150°C	leads > 15.3	
							$R_{th\,j-mb}$ = 10°C/W	TO-126	BD140

BD139/BD140 matched pair	$h_{FE1}/h_{FE2} < 1.6$	|0.15|	|2|						
BD181	$V_{BE} < 1.5$ V	3	4	$I_{CBO} < 2$ mA	0	45	I_C = 10 A	length < 39.5	
n-p-n	$h_{FE} = 40$	3	4				I_{CM} = 15 A	width < 26.6	
hi-fi ampl.	$f_{hfe} > 15$ kHz	0.3	4				V_{CEO} = 45 V	height < 9.5	
20 W into 4 Ω							P_{tot} = 78 W	leads > 11	
15 W into 8 Ω							T_j = 200° C		
							$R_{th\,j-mb}$ = 1.5° C/W		
2-BD181 matched pair	$h_{FE1}/h_{FE2} < 1.3$	3	4						
BD182	$V_{BE} < 1.5$ V	4	4	$I_{CBO} < 5$ mA	0	60	I_C = 15 A	length < 39.5	
n-p-n	$h_{FE} = 40$	4	4				I_{CM} = 15 A	width < 26.6	
hi-fi ampl.	$f_{hfe} > 15$ kHz	0.3	4				V_{CEO} = 60 V	height < 9.5	
40 W into 4 Ω							P_{tot} = 117 W	leads > 11	
							T_j = 200° C		
							$R_{th\,j-mb}$ = 1.5° C/W		
2-BD182 matched pair	$h_{FE1}/h_{FE2} < 1.3$	4	4						
BD183	$V_{BE} < 1.5$ V	3	4	$I_{CBO} < 5$ mA	0	80	I_C = 15 A	length < 39.5	
n-p-n	$h_{FE} = 40$	3	4				I_{CM} = 15 A	width < 26.6	
hi-fi ampl.	$f_{hfe} > 15$ kHz	0.3	4				V_{CEO} = 80 V	height < 9.5	
40 W into 8 Ω							P_{tot} = 117 W	leads > 11	
							T_j = 200° C		
							$R_{th\,j-mb}$ = 1.5° C/W		
2-BD183 matched pair	$h_{FE1}/h_{FE2} < 1.3$	3	4						

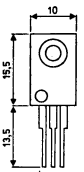
BD181

BD182

BD183

POWER TRANSISTORS

Type and applications	Characteristics at:	I_C (A)	V_{CE} (V)	Characteristics at:	I_E (A)	V_{CB} (V)	Ratings	Outlines (mm)
BD201 n-p-n hi-fi ampl.	$V_{BE} < 1{,}5$ V $h_{FE} > 30$ $f_{hfe} > 25$ kHz $f_T > 3$ MHz	1 0,3 0,3	2 3 3	$I_{CBO} < 1$ mA at $T_j = 150°C$ $V_{CEsat} < 1$ V at $I_C = 3$ A; $I_B = 0{,}3$ A	0	40	$I_C = 8$ A $I_{CM} = 12$ A $V_{CEO} = 45$ V $P_{tot} = 60$ W $T_j = 150°C$ $R_{th\,j-mb} = 2°C/W$	length = 15,5 width = 10 height = 4 leads = 13,5
BD202 p-n-p hi-fi ampl.	$-V_{CE} < 1{,}5$ V $h_{FE} > 30$ $f_{hfe} > 25$ kHz $f_T > 3$ MHz	−1 −0,3 −0,3	−2 −3 −3	$-I_{CBO} < 1$ mA $T_j = 150°C$ $V_{CEsat} < 1$ V at $-I_C = 3$ A; $-I_B = 0{,}3$ A	0	−40	$-I_C = 8$ A $-I_{CM} = 12$ A $-V_{CEO} = 45$ V $P_{tot} = 60$ W $T_j = 150°C$ $R_{th\,j-mb} = 2°C/W$	length = 15,5 width = 10 height = 4 leads = 13,5
BD203	Equivalent to BD201 except for			$V_{CEO} = 60$ V				
BD204	Equivalent to BD202 except for			$-V_{CEO} = 60$ V				
BD226 n-p-n audio ampl.	$V_{BE} < 1{,}3$ V h_{FE} 40-250 $h_{FE} > 25$ $f_T = 125$ MHz	1 0,15 1 0,05	2 2 2 5	$I_{CBO} < 100$ nA $V_{CEsat} < 0{,}8$ V at $I_C = 1$ A; $I_B = 0{,}1$ A	0	30	$I_C = 1{,}5$ A $I_{CM} = 3$ A $V_{CEO} = 45$ V $P_{tot} = 12{,}5$ W $T_j = 150°C$ $R_{th\,j-mb} = 7°C/W$	length < 11,1 width < 7,8 height < 2,8 leads > 15,3



BD201
BD202
BD203
BD204

BD226

BD227	$-V_{BE}<1{,}3$ V	−1	−2	$-I_{CBO}<100$ nA	0	−30	$-I_C$ = 1,5 A	length < 11,1
p-n-p	h_{FE} 40-250	−0,15	−2	$-V_{CE\,sat}<0{,}8$ V at	$-I_C=1$ A;		$-I_{CM}$ = 3 A	width < 7,8
audio ampl.	$h_{FE}>25$	−1	−2		$-I_B=0{,}1$ A		$-V_{CEO}$ = 45 V	height < 2,8
	f_T = 125 MHz	−0,05	−5				P_{tot} = 12,5 W	leads > 15,3
							T_j = 150°C	
							$R_{th\,j-mb}$ = 7°C/W	

B
C
E
BD227

BD226/BD227 matched pair	h_{FE1}/h_{FE2}	0,15	2
BD228	Equivalent to BD226 except for: h_{FE} 40-160	0,15	2
BD229	Equivalent to BD227 except for: h_{FE} 40-160	−0,15	−2
BD228/BD229 matched pair	$h_{FE1}/h_{FE2}<1{,}6$	0,15	2
BD230	Equivalent to BD226 except for: h_{FE} 40-160	0,15	2
BD231	Equivalent to BD227 except for: h_{FE} 40-160	−0,15	−2
BD230/BD231 matched pair	$h_{FE1}/h_{FE2}<1{,}6$	|0,15|	|2|

BD226/BD227 matched pair	
BD228	$V_{CEO}=60$ V
BD229	$-V_{CEO}=60$ V
BD228/BD229 matched pair	
BD230	$V_{CEO}=80$ V
BD231	$V_{CEO}=80$ V
BD230/BD231 matched pair	

POWER TRANSISTORS

Type and applications	*Characteristics at:*	I_C (A)	V_{CE} (V)	*Characteristics at:*	I_E (A)	V_{CB} (V)	*Ratings*	*Outlines (mm)*	
BD232 n-p-n line driver television	I_{CES} < 0,1 V_{BE} < 1 V h_{FE} 25-50 h_{FE} > 20 f_T = 20 MHz	– 0,15 0,05 0,15 0,05	500 5 5 5 10	$V_{CE\,sat}$ < 1 V at I_C = 150 mA; I_B = 15 mA			I_C = 0,25 A I_{CM} = 1 A V_{CEO} = 300 V P_{tot} = 7 W T_j = 125°C $R_{th\,j-mb}$ = 9°C/W	length < 11,1 width < 7,8 height < 2,8 leads > 15,3 TO-126	B C E BD232
BD233 n-p-n amplifier high peak power	V_{BE} < 1,3 V h_{FE} > 25 f_T > 3 MHz	1 1 0,25	2 2 10	I_{CBO} < 100 μA 0 45 $V_{CE\,sat}$ < 0,6 V at I_C = 1 A; I_B = 0,1 A t_{off} = 1,1 μs at I_C = 1 A; $I_{BM} = -I_{BM}$ = 0,1 A			I_C = 2 A I_{CM} = 6 A V_{CEO} = 45 V P_{tot} = 25 W T_j = 150°C $R_{th\,j-mb}$ = 5°C/W	length < 11,1 width < 7,8 height < 2,8 leads > 15,3 TO-126	B C E BD233
BD234 p-n-p amplifier high peak power	$-V_{BE}$ < 1,3 h_F > 25 f_T > 3 MHz	–1 –1 –0,25	–2 –2 –10	$-I_{CBO}$ < 100 μA 0 45 $-V_{CE\,sat}$ < 0,6 V at $-I_C$ = 1 A; I_B = 0,1 A t_{off} = 0,7 μs at $-I_C$ = 1 A; $-I_{BM} = I_{BM}$ = 0,1 A			$-I_C$ = 2 A $-I_{CM}$ = 6 A $-V_{CEO}$ = 45 V P_{tot} = 25 W T_j = 150°C $R_{th\,j-mb}$ = 5°C/W	length < 11,1 width < 7,8 height < 2,8 leads > 15,3 TO-126	B C E BD234
BD235	Equivalent to BD233 except for:			I_{CBO} < 100 μA 0		60	V_{CEO} = 60 V		
BD236	Equivalent to BD234 except for:			$-I_{CBE}$ < 100 μA 0		60	$-V_{CEO}$ = 60 V		
BD237	Equivalent to BD233 except for:			I_{CBO} < 100 μA 0		100	V_{CEO} = 80 V		

BD238	Equivalent to BD234 except for:			$-I_{CBO}<100\ \mu A$	0	100	$-V_{CEO}=80$ V		
BD433	$V_{BE}=0{,}58$ V	0,1	5	$I_{CBO}<100\ \mu A$	0	22	I_C	=4 A	length <11,1
p-n-p	$h_{FE}>40$	0,1	5	$V_{CE\,sat}<0.5$ V at $I_C=2$ A;			I_{CM}	=7 A	width < 7,8
l.f. output	$h_{FE}>50$	2	1	$I_B=0{,}2$ A			V_{CEO}	=22 V	height <2,8
	f_T >3 MHz	0,25	1				P_{tot}	=36 W	leads >15,3
							T_j	=150°C	TO-126
							$R_{th\,j-mb}$	=6°C/W	
BD434	$-V_{BE}=0{,}58$ V	−0,1	−5	$-I_{CBO}<100\ \mu A$	0	22	$-I_C$	=4 A	length <11,1
n-p-n	$h_{FE}>40$	−0,1	−5	$-V_{CE\,sat}<0{,}5$ V at			$-I_{CM}$	= 7 A	width <7,8
l.f. output	$h_{FE}>50$	−2	−1	$-I_C=2$ A;			$-V_{CEO}$	= 22 V	height <2,8
	f_T >3 MHz	−0,25	−1	$-I_B=0{,}2$ A			P_{tot}	=36 W	leads >15,3
							T_j	=150°C	TO-126
							$R_{th\,j-mb}$	=6°C/W	
BD433/BD434 matched pair car radios	$h_{FE1}/h_{FE2}<1.4$	|0,5|	|1|						
BD435	Equivalent to BD433 except for:			$I_{CBO}<100\ \mu A$	0	32	V_{CEO}	=32 V	
BD436	Equivalent to BD434 except for:			$-I_{CBO}<100\ \mu A$	0	−32	$-V_{CEO}$	=32 V	
BD435/BD436 matched pair	$h_{FE1}/h_{FE2}<1{,}4$	|0,5|	|1|						
BD437	Equivalent BD433 except for:								
	$h_{FE}>30$	0,1	5	$I_{CBO}<100\ \mu A$	0	45	V_{CEO}	=45 V	
	$h_{FE}>40$	2	1	$V_{CE\,sat}<0{,}7$ at $I_C=3$ A;					
				$I_B=0{,}3$ A					

BD433

BD434

POWER TRANSISTORS

Type and applications	Characteristics at:	I_C (A)	V_{CE} (V)	Characteristics at:	I_E (A)	V_{CB} (V)	Ratings	Outlines (mm)
BD438	Equivalent to BD434 except for:							
	$h_{FE} > 30$	−0,1	−5	$-I_{CBO} < 100\ \mu A$	0	−45	$-V_{CEO} = 45$ V	
	$h_{FE} > 40$	−2	−1	$-V_{CE\,sat} < 0{,}7$ V at	$-I_C = 3$ A; $-I_B = 0{,}3$ V			
BD437/BD438 matched pair hi-fi output	$h_{FE}/h_{FE2} < 1{,}8$	|0.5|	|1|					
BDY20 n-p-n hi-fi signal processing	$V_{BE} < 1.8$ V	4	4	$I_{CBO} < 5$ mA	0	100	$I_{CM} = 15$ A	length < 39.5
	$h_{FE} > 20$	4	4	$C_c = 250$ pF	0	20	$V_{CEO} = 60$ V	width < 26.6
	$f_T = 1$ MHz	1	4				$P_{tot} = 115$ W	height < 9.5
	$f_{hfe} = 9$ kHz	1	4				$T_j = 200$°C	leads > 11
							$R_{th\,j-mb} = 1.5$°C/W	
2-BDY20 matched pair	$h_{FE1}/h_{FE2} < 1.6$	0.4	4					
	$h_{FE1}/h_{FE2} < 1.3$	4	4					
BDY38 n-p-n hi-fi signal processing	$V_{BE} < 2$ V	2	4	$I_{CBO} < 1$ mA	0	50	$I_{CM} = 6$ A	length < 39.5
	$h_{FE} > 30$	0.2	4	$C_c = 250$ pF	0	20	$V_{CEO} = 40$ V	width < 26.6
	$f_T = 1$ MHz	1	4				$P_{tot} = 115$ W	height < 9.5
	$f_{hfe} = 12$ kHz	1	4				$T_j = 200$°C	leads > 11
							$R_{th\,j-mb} = 1.5$°C/W	
2-BDY38 matched pair	$h_{FE1}/h_{FE2} < 1.5$	0.2	4					
	$h_{FE1}/h_{FE2} < 1.2$	2	4					

BDY20

BDY38

BDY60 n-p-n switching inverters regulators	$h_{FE}>45$ $h_{FE}>18$ $f_T=100$ MHz	0.5 5 0.5	10 2 5	$I_{CBO}<10\ \mu A$ $C_c<80$ pF	0 0	100 10	$I_C=5$ A $I_{CM}=10$ A $V_{CEO}=60$ V $P_{tot}=15$ W $T_j=175°C$ $R_{th\,j-mb}=5°C/W$	length <39.5 width <26.6 height < 9.5 leads >11	 BDY60
BDY61 n-p-n switching inverters regulators.	$h_{FE}>45$ $h_{FE}>15$ $f_T=100$ MHz	0.5 5 0.5	10 2 5	$I_{CBO}<10\ \mu A$ $C_c<80$ pF	0 0	80 10	$I_C=5$ A $I_{CM}=10$ A $V_{CEO}=60$ V $P_{tot}=15$ W $T_j=175°C$ $R_{th\,j-mb}=5°C/W$	length <39.5 width <26.6 height < 9.5 leads >11	 BDY61
BDY90 n-p-n convertors inverters regulators	$h_{FE}>35$ $h_{FE}>20$ $f_T=70$ MHz	1 10 0.5	2 5 5				$I_C=10$ A $I_{CM}=15$ A $V_{CEO}=100$ V $P_{tot}=40$ W $T_j=175°C$ $R_{th\,j-mb}=2.5°C/W$	length <39.5 width <26.6 height < 9.5 leads >11	 BDY90
BDY91	Equivalent to BDY90 except for:						$V_{CEO}=80$ V		
BDY92	Equivalent to BDY90 except for:						$V_{CEO}=60$ V		
BDY93 n-p-n converters inverters regulators	h_{FE} 15-60 $h_{FE}>5$ $f_T=8$ MHz $t_f<0{,}6\ \mu s$	1 3 0,2 2,5	5 5 10 –	$C_c=85$ pF $V_{CE\,sat}<1{,}5$ V at	0	10	$I_C=3$ A $I_{CM}=6$ A $V_{CEO}=350$ V $P_{tot}=30$ W $T_j=125°C$ $R_{th\,j-mb}=2{,}5°C/W$	length <39,5 width <26,6 height < 9,5 leads >11	 BDY93

POWER TRANSISTORS

Type and applications	*Characteristics at:*	I_C (A)	V_{CE} (V)	*Characteristics at:*	I_E (A)	V_{CB} (V)	*Ratings*	*Outlines (mm)*
BDY94	Equivalent to BDY93 except for:							
	h_{FE} 25-80	1	5				V_{CEO} = 300 V	
	t_f < 1 μs	2,5	–					
BDY95	Equivalent to BDY94 except for:						V_{CEO} = 250 V	
BDY96	h_{FE} 15-60	2	5	$V_{CE\,sat}$ < 1 V at	I_C = 2,5 A;		I_C = 10 A	length < 39,5
n-p-n	f_T = 10 MHz	0,2	10		I_B = 0,5 A		I_{CM} = 15 A	width < 26,6
converters	t_f < 0,4	5	–				V_{CEO} = 350 V	height < 9,5
inverters							P_{tot} = 40 W	leads > 11
regulators							T_j = 125°C	
							$R_{th\,j-mb}$ = 1,5°C/W	
BDY97	Equivalent to BDY96 except for:			$V_{CE\,sat}$ < 1,5 V at	I_C = 5 A;			
	h_{FE} 25-80	2	5		I_B = 1 A		V_{CEO} = 300 V	
	t_f < 0,9	5	–					
BDY98	Equivalent to BDY96 except for:			$V_{CE\,sat}$ < 1,5 V at	I_C = 5 A;			
	h_{FE} 25-80	2	5		I_B = 1 A		V_{CEO} = 250 V	
	t_f < 0,9	5	–					
BDY99	Equivalent to BDY 96 except for:							
	h_{FE} = 36	2	5	$V_{CE\,sat}$ < 1,5 V at	I_C = 5 A;		V_{CEO} = 250 V	
	t_f = 0,5	5	–		I_B = 1 A			

BDY96

2N3055	V_{BE} < 1.8 V	4	4				I_C = 15 A	length < 39.5
n-p-n	h_{FE} > 20	4	4				V_{CER} = 70 V	width < 26.6
hi-fi	f_T > 0.8 MHz	1	4				P_{tot} = 115 W	height < 9.5
signal	f_{hfe} > 15 kHz	1	4				T_j = 200°C	leads > 11
processing							$R_{th\,j-mb}$ = 1.5°C/W	

2N3055

2N3442	V_{BE} < 1.7 V	3	4	I_{CBO} = 50 μA	0	140	I_{CM} = 15 A	length < 39.5
n-p-n	V_{BE} < 5.7 V	10	4	C_c = 100 pF	0	50	V_{CEO} = 140 V	width < 26.6
audio ampl.	h_{FE} > 20	3	4				P_{tot} = 117 W	height < 9.5
power suppl.	h_{FE} > 7.5	10	4				T_j = 200°C	leads > 11
converters	h_{fe} > 2	2	4				$R_{th\,j-mb}$ = 1.5°C/W	

2N3442

2N3771	V_{BE} < 2.7 V	15	4	I_{CBO} < 2 mA	0	50	I_C = 30 A	length < 39.5
n-p-n	h_{FE} > 5	30	4				I_{CM} = 30 A	width < 26.6
un-tuned	h_{FE} > 15	15	4				V_{CEO} = 40 V	leads > 11
amplifiers	h_{fe} > 4	1	4				P_{tot} = 150 W	height < 9.5
							T_j = 200°C	
							$R_{th\,j-mb}$ = 1.17°C/W	

2N3771

2N3772	V_{BE} < 2.2 V	10	4	I_{CBO} < 5 mA	0	100	I_C = 20 A	length < 39.5
n-p-n	h_{FE} > 5	20	4				I_{CM} = 30 A	width < 26.6
un-tuned	h_{FE} > 15	10	4				V_{CEO} = 60 V	height < 9.5
amplifiers	h_{fe} > 4	1	4				P_{tot} = 150 W	leads > 11
							T_j = 200°C	
							$R_{th\,j-mb}$ = 1.17°C/W	

2N3772

2N4347	V_{BE} < 2.0 V	2	4	I_{CBO} = 50 μA	0	140	I_{CM} = 10 A	length < 39.5
n-p-n	V_{BE} < 4.0 V	5	4	C_c = 100 pF	0	50	V_{CEO} = 120 V	width < 26.6
audio ampl.	h_{FE} > 20	2	4				P_{tot} = 100 W	height < 9.5
power suppl.	h_{FE} > 7.5	5	4				T_j = 200°C	leads > 11
converters							$R_{th\,j-mb}$ = 1.5°C/W	

2N4347

TRANSMITTING TRANSISTORS

Type and applications	*Characteristics at*	I_C (A)	V_{CE} (V)	V_{CC} (V)	*Characteristics at*	I_E (A)	V_{CB} (V)	*Ratings*	*Outlines (mm)*
BFS22A	$h_{FE} > 5$	0.5	5	—	$C_c < 20$ pF	0	15	$I_{CM} = 0.75$ A	length < 6.6
n-p-n	$f_T = 700$ MHz	0.35	10	—				$V_{CEO} = 18$ V	width < 8.5
class A, B, C	$-C_{re} = 11$ pF	0.05	15	—				$P_{tot} = 8$ W	leads > 12.7
transmitter	$P_L = 4$ W	0.49	—	13.5				$T_j = 200$°C	
	$P_S < 0.63$ W	0.49	—	13.5				$R_{th\,j-mb} = 22$°C/W	
	$G_p > 8$ dB	0.49	—	13.5					
	$\eta > 60\%$	0.49	—	13.5					
BFS23A	$h_{FE} > 5$	0.5	5	—	$C_c < 15$ pF	0	30	$I_{CM} = 1.5$ A	length < 6.6
n-p-n	$f_T = 500$ MHz	0.4	20	—				$V_{CEO} = 36$ V	width < 8.5
class A, B, C	$-C_{re} = 7.5$ pF	0.025	30	—				$P_{tot} = 8$ W	leads > 12.7
transmitter	$P_L = 4$ W	0.22	—	28				$T_j = 200$°C	
	$P_S < 0.4$ W	0.22	—	28				$R_{th\,j-mb} = 22$°C/W	
	$G_p > 10$ dB	0.22	—	28					
	$\eta > 65\%$	0.22	—	28					
BFY44	$h_{FE} = 20$	0,15	10		$I_{CBO} < 500$ nA	0	40	$I_{CM} = 1$ A	length < 6.6
n-p-n	$h_{FE} = 20$	0,5	5		$C_c < 12$ pF	0	40	$V_{CEO} = 60$ V	width < 8.5
v.h.f.	$f_T = 210$ MHz	0,1	10		$\lvert y_{fb} \rvert = 98$ mΩ^{-1}	−150	24	$P_{tot} = 5$ W	leads > 12,7
transmitter	$P_o = 2.1$ W	—	40					$T_j = 200$°C	
	$G_p = 7$ dB	—	40					$R_{th\,j-a} = 0.035$°C/mW	
	$\eta = 50\%$	—	40						

BFY70
n-p-n
v.h.f.
transmitter

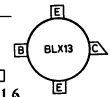
h_{FE} = 20	0,15	10		I_{CBO} < 500 nA	0	28	I_{CM} = 1 A
h_{FE} = 20	0,5	5		C_c < 14 pF	0	28	V_{CEO} = 40 V
f_T = 210 MHz	0,1	10		$\|y_{fb}\|$ = 98 mΩ^{-1}	−150	24	P_{tot} = 5 W
P_o = 1.5 W	—	28					T_j = 200°C
G_p = 7 dB	—	28					$R_{th\,j-c}$ = 0.035°C/mW
η = 50%	—	28					

length < 6.6
width < 8.5
leads > 38

BLX13
n-p-n
class A,AB
f.m. (class C)
transmitter

h_{FE} = 50	1	5	—	C_c = 50 pF	0	30	I_{CM} = 6 A
f_T = 500 MHz	3	20	—				V_{CEO} = 36 V
$-C_{re}$ = 31 pF	0.1	30	—				P_{tot} = 62.5 W
P_L = 25 W	1.49	—	28				T_j = 200°C
P_S = 0.5 W	1.49	—	28				$R_{th\,j-mb}$ = 2.5°C/W
G_p = 17 dB	1.49	—	28				
η = 60%	1.49	—	28				

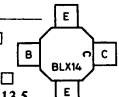
diameter = 9.5
height < 5.75
leads < 26.5 □
stud length < 11.6
stud: 10–32 UNF



BLX14
n-p-n
class A, AB, B
h.f.; v.h.f.
transmitter

h_{FE} > 15	1.4	6	—	C_c = 115 pF	0	30	I_{CM} = 12 A
f_T = 250 MHz	3.0	10	—				V_{CEO} = 36 V
$-C_{re}$ = 90 pF	0.1	30	—				P_{tot} = 88 W
P_L < 50 W	2.55	—	28				T_j = 200°C
G_p > 13 dB	2.55	—	28				$R_{th\,j-mb}$ = 1.8°C/W
d_3 = −30 dB	2.55	—	28				
η > 35%	2.55	—	28				

width = 14 □
height < 8.5
leads < 27.2 □
stud length < 13.5
stud: $\frac{1}{4}$" × 28 UNF



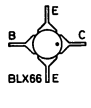
BLX65
n-p-n
class B, C
u.h.f./v.h.f.
transmitter

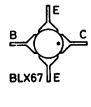
h_{FE} > 10	0,1	5	–	C_c = 6,5 pF	0	10	I_{CM} = 2,0 A
f_T = 1,4 GHz	0,2	5	–				V_{CEO} = 18 V
$-C_{re}$ = 4,8 pF	0,02	10	–				P_{tot} = 3,0 W
P_L = 2,0 W	0,25	–	12,5				T_j = 165°C
G_p > 6 dB	0,25	–	12,5				$R_{th\,j-c}$ = 25°C/W
η < 65%	0,25	–	12,5				

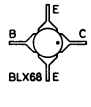
length < 6,6
width < 8,5
leads > 12,7

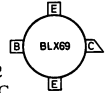
TRANSMITTING TRANSISTORS

Type and applications	*Characteristics at*	I_C (A)	V_{CE} (V)	V_{CC} (V)	*Characteristics at:*	I_E (A)	V_{CB} (V)	*Ratings*	*Outlines (mm)*
BLX66	$h_{FE} > 10$	0,1	5	–	$C_c = 6{,}5$ pF	0	10	$I_{CM} = 2{,}0$ A	diameter < 9,75
n-p-n	$f_T = 1{,}4$ GHz	0,2	5	–				$V_{CEO} = 18$ V	height < 5,75
class B, C	$-C_{re} = 4{,}8$ pF	0,02	10	–				$P_{tot} = 4{,}0$ W	leads > 25 □
u.h.f./v.h.f.	$P_L = 2{,}5$ W	0,31	–	12,5				$T_j = 150°C$	no stud
transmitter	$G_p > 8{,}5$ dB	0,31	–	12,5				$R_{th\,j-mb} = 12°C/W$	
	$\eta > 65\%$	0,31	–	12,5					
BLX67	$h_{FE} > 10$	0,1	5	–	$C_c = 6{,}5$ pF	0	10	$I_{CM} = 2{,}0$ A	diameter < 9.75
n-p-n	$f_T = 1{,}4$ GHz	0,2	5	–				$V_{CEO} = 18$ V	height < 5,75
class B, C	$-C_{re} = 4{,}8$ pF	0,02	10	–				$P_{tot} = 4{,}5$ W	leads > 25 □
u.h.f./v.h.f.	$P_L = 3{,}0$ W	0,28	–	13,8				$T_j = 150°C$	stud length < 12,0
transmitter	$G_p = 9{,}3$ dB	0,28	–	13,8				$R_{th\,j-mb} = 12°C/W$	stud: 8-32 UNC
	$\eta = 79\%$	0,28	–	13,8					
BLX68	$h_{FE} > 10$	0,5	5	–	$C_c = 14$ pF	0	10	$I_{CM} = 4{,}0$ A	diameter < 9,75
n-p-n	$f_T = 1{,}3$ GHz	0,5	5	–				$V_{CEO} = 18$ V	height < 5,75
class B, C	$-C_{re} = 10{,}5$ pF	0,05	10	–				$P_{tot} = 10$ W	leads > 25 □
u.h.f./v.h.f.	$P_L = 7{,}8$ W	0,81	–	13,8				$T_j = 150°C$	stud length < 12,0
transmitter	$G_p = 5{,}9$ dB	0,81	–	13,8				$R_{th\,j-mb} = 7{,}0°C/W$	stud: 8-32 UNC
	$\eta = 70\%$	0,81	–	13,8					
BLX69	$h_{FE} = 30$	1	5	—	$C_c = 55$ pF	0	15	$I_{CM} = 10$ A	diameter < 9.7
n-p-n	$f_T = 1$ GHz	2	10	—				$V_{CEO} = 18$ V	height < 5.75
class A, B, C	$-C_{re} = 32$ pF	0.1	15	—				$P_{tot} = 50$ W	leads > 25 □
transmitter	$P_L = 20$ W	2.28	—	13.5				$T_j = 200°C$	stud length < 12
	$G_p > 4$ dB	2.28	—	13.5				$R_{th\,j-mb} = 2.9°C/W$	stud: 8–32 UNC
	$\eta > 65\%$	2.28	—	13.5					





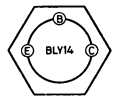




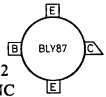
BLX91	$h_{FE} > 10$	0,1	5,0	–	$C_c = 3{,}5$ pF	0	10	I_{CM} = 800 mA	diameter < 9,75
n-p-n	f_T = 1,2 GHz	0,05	5,0	–				V_{CEO} = 33 V	height < 5,75
class A, B, C	$-C_{re}$ = 2,5 pF	0,085	10	–				P_{tot} = 4,0 W	leads > 25 □
u.h.f.	P_L = 1,45 W	0,086	–	28				T_j = 200°C	stud length < 12,0
transmitter	G_p = 12,6 dB	0,086	–	28				$R_{th\,j-mb}$ = 32,5°C/W	stud: 8-32 UNC
	η = 60%	0,086	–	28					
BLX92	$h_{FE} > 10$	0,1	5,0	–	$C_c = 6{,}5$ pF	0	10	I_{CM} = 2,0 A	diameter < 9,75
n-p-n	f_T = 1,2 HGz	0,1	5,0	–				V_{CEO} = 33 V	height < 5,75
class A, B, C	$-C_{re}$ = 4,8 pF	0,01	10	–				P_{tot} = 6,0 W	leads > 25 □
u.h.f.	P_L = 3,0 W	0,162	–	28				T_j = 200°C	stud length < 12,0
transmitter	G_p = 11,7 dB	0,162	–	28				$R_{th\,j-mb}$ = 21,4°C/W	stud: 8-32 UNC
	η = 66%	0,162	–	28					
BLX93	$h_{FE} > 10$	0,1	5,0	–	$C_c = 14$ pF	0	10	I_{CM} = 3,0 A	diameter < 9.75
n-p-n	f_T = 1,2 GHz	0,2	5,0	–				V_{CEO} = 33 V	height < 5,75
class A, B, C	$-C_{re}$ = 10 pF	0,02	10	–				P_{tot} = 12,5 W	leads > 25 □
u.h.f.	P_L = 8,0 W	0,38	–	28				T_j = 150°C	stud length < 12,0
transmitter	G_p = 9,0 dB	0,38	–	28				$R_{th\,j-mb}$ = 9.8°C/W	stud: 8-32 UNC
	η = 75%	0,38	–	28					
BLX94	$h_{FE} > 15$	1	5	–	$C_c = 32$ pF	0	30	I_{CM} = 6,0 A	diameter < 9,7
n-p-n	f_T = 1,0 GHz	2	20	–				V_{CEO} = 33 V	height < 5,75
class A, B, C	$-C_{re}$ = 18 pF	0,1	30	–				P_{tot} = 50 W	leads > 25 □
u.h.f.	P_L = 20 W	1,3	–	28				T_j = 200°C	stud length < 12,0
transmitter	G_p > 6 dB	1,3	–	28				$R_{th\,j-mb}$ = 2,9°C/W	stud: 8-32 UNC
	η > 55%	1,3	–	28					

TRANSMITTING TRANSISTORS

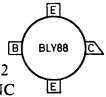
Type and applications	Characteristics at:	I_C (A)	V_{CE} (V)	V_{CC} (V)	Characteristics at:	I_E (A)	V_{CB} (V)	Ratings	Outlines (mm)
BLY14	f_T = 190 MHz	0.1	10		I_{CBO} < 500 nA	0	40	I_{CM} = 1 A	length < 28.2
n-p-n	P_o = 3.6 W	0.19	40		h_{FE} = 11	−0.15	10	V_{CEO} = 55 V	width < 28.2
transmitter	G_p = 7.6	0.19	40		h_{FE} = 11	−0.5	10	P_{tot} = 8.75 W	height < 10.5
h.f.	η = 48%	0.19	40		C_c < 10 pF	0	40	T_j = 200°C	leads = 17
					$\lvert y_{fb}\rvert$ = 98 mΩ^{-1}	−0.15	24	$R_{th\,j-mb}$ = 20°C/W	collector: M5
BLY17	f_T = 70 MHz	1.5	10		I_{CBO} < 10 mA	0	40	I_{CM} = 10 A	length < 28.2
n-p-n	P_o = 40 W	1.8	40		I_{CBO} < 20 mA	0	100	V_{CER} = 100 V	width < 28.2
transmitter	G_p = 7.5 dB	1.8	40		h_{FE} = 13	−5	0	P_{tot} = 100 W	height < 10.5
h.f.	η = 55%	1.8	40		h_{FE} = 9	−10	0	T_j = 175°C	leads = 17
					C_c < 150 pF	0	40	$R_{th\,j-mb}$ = 1.5°C/W	collector: M5
BLY83	h_{FE} = 60	1	5	—	C_c < 45 pF	0	10	I_{CM} = 2.5 A	diameter < 9.75
n-p-n	f_T = 450 MHz	1	5	—				at f < 1 MHz	height < 5.75
a.m.; f.m.	P_L = 13 W	0.84	—	24				I_{CM} = 7.5 A	leads > 25 □
class B	G_p = 9.8 dB c.w.	0.84	—	24				at f > 1 MHz	stud length < 12.0
transmitter	η = 65%	0.84	—	24				V_{CEO} = 33 V	stud: 8–32 UNC
	P_L = 7 W	0.66	—	13.8				P_{tot} = 12 W	
	G_p = 13 dB a.m.	0.66	—	13.8				T_{stg}: −65 to +150°C	
	η = 77%	0.66	—	13.8					
BLY84	h_{FE} = 60	1	5	—	C_c < 45 pF	0	10	I_{CM} = 2.5 A	diameter < 9.75
n-p-n	f_T = 450 MHz	1	5	—				at f < 1 MHz	height < 5.75
f.m.	P_L = 13 W	1.2	—	13.8				I_{CM} = 7.5 A	leads > 25 □
class B	G_p = 5.8 dB c.w.	1.2	—	13.8				at f > 1 MHz	stud length < 12.0
transmitter	η = 80%	1.2	—	13.8				V_{CEO} = 20 V	stud: 8–32 UNC
								P_{tot} = 12 W	
								T_{stg}: −65 to +150°C	



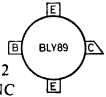
BLY87A	$h_{FE} > 5$	0.5	5	—	$C_c < 20$ pF	0	15	I_{CM} = 3.75 A	diameter < 9.6	
n-p-n	f_T = 700 MHz	0.5	10	—				V_{CEO} = 18 V	height < 5.75	
class A, B, C	$-C_{re}$ = 11 pF	0.1	15	—				P_{tot} = 17.5 W	leads > 25	
v.h.f.	P_L = 8 W	0.85	—	13.5				T_j = 200°C	stud length < 12	
transmitter	G_p > 9 dB (B)	0.85	—	13.5				$R_{th\,j-mb}$ = 9.4°C/W	stud: 8–32 UNC	
	η > 70% (B)	0.85	—	13.5						



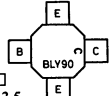
BLY88A	$h_{FE} > 5$	0.5	5	—	$C_c < 40$ pF	0	15	I_{CM} = 7.5 A	diameter < 9.6	
n-p-n	f_T = 700 MHz	1	10	—				V_{CEO} = 18 V	height < 5.75	
class A, B, C	$-C_{re}$ = 25 pF	0.1	15	—				T_j = 200°C	leads > 25	
v.h.f.	P_L = 15 W	1.71	—	13.5				P_{tot} = 32 W	stud length < 12	
transmitter	G_p > 7.5 dB (B)	1.71	—	13.5				$R_{th\,j-mb}$ = 4.9°C/W	stud: 8–32 UNC	
	η > 65% (B)	1.71	—	13.5						



BLY89A	$h_{FE} = 50$	1	5	—	$C_c < 90$ pF	0	15	I_{CM} = 10 A	diameter < 9.6	
n-p-n	f_T = 650 MHz	4	10	—				V_{CEO} = 18 V	height < 5.75	
class A, B, C	$-C_{re}$ = 41 pF	0.1	15	—				P_{tot} = 70 W	leads > 25	
v.h.f.	P_L = 25 W	2.64	—	13.5				T_j = 200°C	stud length < 12	
transmitter	G_p > 6 dB (B)	2.64	—	13.5				$R_{th\,j-mb}$ = 2.5°C/W	stud: 8–32 UNC	
	η > 70% (B)	2.64	—	13.5						

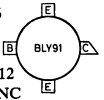


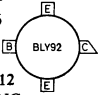
BLY90	$h_{FE} > 10$	1	5	—	$C_c < 160$ pF	0	15	I_{CM} = 20 A	width = 14 □	
n-p-n	f_T = 550 MHz	6	10	—				V_{CEO} = 18 V	height < 8.5	
class A, B, C	$-C_{re}$ = 82 pF	0.2	15	—				P_{tot} = 130 W	leads < 27.2 □	
v.h.f.	P_L = 50 W	5.33	—	12.5				T_j = 200°C	stud length < 13.5	
transmitter	G_p > 5 dB (B)	5.33	—	12.5				$R_{th\,j-mb}$ = 1.35°C/W	stud: $\frac{1}{4}$" × 28 UNF	
	η > 75% (B)	5.33	—	12.5						

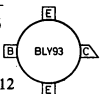


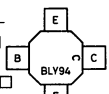
TRANSMITTING TRANSISTORS

Type and applications	Characteristics at:	I_C (A)	V_{CE} (V)	V_{CC} (V)	Characteristics at:	I_E (A)	V_{CB} (V)	Ratings	Outlines (mm)
BLY91A	$h_{FE} > 5$	0.5	5	—	$C_c < 15$ pF	0	30	$I_{CM} = 2.25$ A	diameter < 9.6
n-p-n	$f_T = 500$ MHz	0.4	20	—				$V_{CEO} = 36$ V	height < 5.75
class A, B, C	$-C_{re} = 7.5$ pF	0.05	30	—				$P_{tot} = 17.5$ W	leads > 25
v.h.f.	$P_L = 8$ W	0.44	—	28				$T_j = 200°C$	stud length < 12
transmitter	$G_p > 12$ dB B	0.44	—	28				$R_{th\,j-mb} = 9.4°C/W$	stud: 8–32 UNC
	$\eta > 65\%$	0.44	—	28					
BLY92A	$h_{FE} > 5$	0.5	5	—	$C_c < 30$ pF	0	30	$I_{CM} = 4.5$ A	diameter < 9.6
n-p-n	$f_T = 500$ MHz	0.6	20	—				$V_{CEO} = 36$ V	height < 5.75
class A, B, C	$-C_{re} = 15$ pF	0.1	30	—				$P_{tot} = 32$ W	leads > 25
v.h.f.	$P_L = 15$ W	0.83	—	28				$T_j = 200°C$	stud length < 12
transmitter	$G_p > 10$ dB B	0.83	—	28				$R_{th\,j-mb} = 4.9°C/W$	stud: 8–32 UNC
	$\eta > 65\%$	0.83	—	28					
BLY93A	$h_{FE} = 50$	1	5	—	$C_c < 65$ pF	0	30	$I_{CM} = 9$ A	diameter < 9.6
n-p-n	$f_T = 500$ MHz	3	20	—				$V_{CEO} = 36$ V	height < 5.75
class A, B, C	$-C_{re} = 31$ pF	0.1	30	—				$P_{tot} = 70$ W	leads > 25
v.h.f.	$P_L = 25$ W	1.5	—	28				$T_j = 200°C$	stud length < 12
transmitter	$G_p > 9$ dB B	1.5	—	28				$R_{th\,j-mb} = 2.5°C/W$	stud: 8–32 UNC
	$\eta > 60\%$	1.5	—	28					
BLY94	$h_{FE} > 10$	1	5	—	$C_c < 130$ pF	0	30	$I_{CM} = 12$ A	width = 14 □
n-p-n	$f_T = 500$ MHz	6	20	—				$V_{CEO} = 36$ V	height < 8.5
class A, B, C	$-C_{re} = 47$ pF	0.1	30	—				$P_{tot} = 130$ W	leads < 27.2 □
v.h.f.	$P_L = 50$ W	2.75	—	28				$T_j = 200°C$	stud length < 13.5
transmitter	$G_p > 7$ dB B	2.75	—	28				$R_{th\,j-mb} = 1.35°C/W$	stud: $\frac{1}{4}''$ × 28 UNF
	$\eta > 65\%$	2.75	—	28					

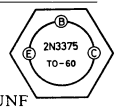


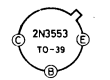


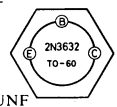


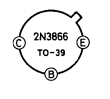


Type and applications	*Characteristics at:*	I_C (*A*)	V_{CE} (*V*)	*Characteristics at:*	I_E (*A*)	V_{CB} (*V*)	*Ratings*	*Outlines (mm)*
2N3375	$V_{BE} < 1.5$ V	0.5	5	$C_c < 10$ pF	0	28	$I_{CM} = 1.5$ A	length < 7.6
n-p-n	$h_{FE} > 15$	0.125	5				$V_{CEO} = 40$ V	width < 8.6
transmitter	$h_{FE} > 10$	0.25	5				$P_{tot} = 11.6$ W	stud < 11.5
v.h.f.	$f_T = 500$ MHz	0.125	28				$T_j = 200$°C	leads 3.9
u.h.f.	$P_o = 7.5$ W	< 0.41	28				$R_{th\,j-mb} = 15$°C/W	stud: 10–32 UNF
	$G_p > 8.7$ dB	< 0.41	28					
	$\eta > 65\%$	< 0.41	28					
2N3553	$V_{BE} < 1.5$ V	0.25	5	$C_c < 10$ pF	0	28	$I_{CM} = 1$ A	length < 6.6
n-p-n	$h_{FE} > 15$	0.125	5				$V_{CEO} = 40$ V	width < 8.5
transmitter	$h_{FE} > 10$	0.25	5				$P_{tot} = 7$ W	leads > 12.7
v.h.f.	$f_T = 500$ MHz	0.125	28				$T_j = 200$°C	
u.h.f.	$P_o = 2.5$ W	< 0.18	28				$R_{th\,j-mb} = 25$°C/W	
	$G_p > 10$ dB	< 0.18	28					
	$\eta > 50\%$	< 0.18	28					
2N3632	$V_{BE} < 1.5$ V	1	5	$C_c < 20$ pF	0	28	$I_{CM} = 3$ A	length < 7.6
n-p-n	$h_{FE} > 10$	0.25	5				$V_{CEO} = 40$ V	width < 8.6
transmitter	$h_{FE} > 5$	1	5				$P_{tot} = 23$ W	stud < 11.5
v.h.f.	$f_T = 400$ MHz	0.25	28				$T_j = 200$°C	leads 3.9
u.h.f.	$P_o > 13.5$ W	0.69	28				$R_{th\,j-mb} = 7.5$°C/W	stud: 10–32 UNF
	$G_p > 5.9$ dB	0.69	28					
	η 70%	0.69	28					
2N3866	$h_{FE} > 10$	0.05	5	$C_c < 3$ pF	0	28	$I_{CM} = 0.4$ A	length < 6.6
n-p-n	$h_{FE} > 5$	0.36	5				$V_{CEO} = 30$ V	width < 8.5
class A, B, C	$f_T = 700$ MHz	0.025	15				$P_{tot} = 5$ W	leads > 12.7
multiplier	$P_o = 1.8$ W	< 0.107	28				$T_j = 200$°C	
oscillator	$\eta > 60\%$	< 0.107	28				$R_{th\,j-mb} = 35$°C/W	



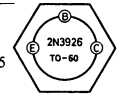






TRANSMITTING TRANSISTORS

Type and applications	*Characteristics at:*	I_C (A)	V_{CE} (V)	*Characteristics at*	I_E (A)	V_{CB} (V)	*Ratings*	*Outlines (mm)*
2N3924	V_{BE} < 1.5 V	0.25	5	C_c < 20 pF	0	13.5	I_{CM} = 1.5 A	length < 6.6
n-p-n	h_{FE} > 10	0.25	5				V_{CEO} = 18 V	width < 8.5
transmitter	f_T > 250 MHz	0.1	13.5				P_{tot} = 7 W	leads > 12.7
v.h.f.	P_o = 4 W	< 0.42	14				T_j = 200°C	
	G_p > 6 dB	< 0.42	14				$R_{th\,j-mb}$ = 25°C/W	
	η > 70%	< 0.42	14					
2N3926	V_{BE} < 1.5 V	0.5	5	C_c < 20 pF	0	13.5	I_{CM} = 3 A	length < 7.6
n-p-n	h_{FE} > 5	0.5	5				V_{CEO} = 18 V	width < 8.6
transmitter	f_T > 250	0.1	13.5				P_{tot} = 11.6 W	stud < 11.5
v.h.f.	P_o = 7 W	< 0.74	14				T_j = 200°C	leads = 3.9
	G_p > 5.4 dB	< 0.74	14				$R_{th\,j-mb}$ = 15°C/W	stud: 10–32 UNF
	η > 70%	< 0.74	14					
2N3927	V_{BE} < 1.5 V	1	5	C_c < 45 pF	0	13.5	I_{CM} = 4.5 A	length < 7.6
n-p-n	h_{FE} > 5	1	5				V_{CEO} = 18 V	width < 8.6
transmitter	f_T > 200 MHz	0.2	13.5				P_{tot} = 23 W	stud < 11.5
v.h.f.	P_o = 12 W	< 1.1	14				T_j = 200°C	leads = 3.9
	G_p > 4.8 dB	< 1.1	14				$R_{th\,j-mb}$ = 7.5°C/W	stud: 10–32 UNF
	η > 80%	< 1.1	14					
2N4427	h_{FE} > 10	0.1	5	C_c < 4 pF	0	12	I_{CM} = 0.4 A	length < 6.6
n-p-n	h_{FE} > 5	0.36	5				V_{CEO} = 20 V	width < 8.5
class A, B, C	f_T = 700 MHz	0.025	10				P_{tot} = 3.5 W	leads > 12.7
multiplier	P_o = 1 W	< 0.167	12				T_j = 200°C	
oscillator	η > 50%	< 0.167	12				$R_{th\,j-mb}$ = 35°C/W	



DEFLECTION TRANSISTORS

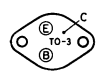
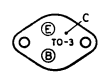
Type and applications	Characteristics at:	I_C (A)	V_{CE} (V)	Characteristics at:	I_E (A)	V_{CB} (V)	Ratings	Outlines (mm)	
BFW45	V_{BE} <1.3 V	50	20	I_{CBO} < 100 nA	0	100	I_{CM} = 100 mA	length < 6.6	
n-p-n	h_{FE} >20	50	20	C_c <6 pF	0	20	V_{CEO} = 130 V	width < 8.5	
horizontal defl.	$-C_{re}$ <3.5 pF	10	20				P_{tot} = 2.5 W	leads >12.7	
oscilloscopes	f_T = 120 MHz	10	10				T_j = 200°C		
							$R_{th\,j-a}$ = 200°C/W		
BU105	V_{BE} = 1 V	2	5	C_c = 65 pF	0	10	I_{CM} = 2.5 A	length < 39.5	
n-p-n	h_{FE} = 8	0.8	5	t_f = 0.75 μs			$-I_{EM}$ = 4.0 A	width < 26.6	
horizontal	f_T = 7.5 MHz	0.1	5	at:			$-I_{BM}$ = 1.5 A	height < 9.5	
deflection				I_{CMnom} = 2 A			V_{CERM} = 1500 V	leads >11	
				$I_{B(end)nom}$ = 1.5 A			P_{tot} = 10 W	TO-3	
				L_B = 10 μH			T_j = 115°C		
							$R_{th\,j-mb}$ = 2.5°C/W		
BU108	h_{FE} = 4	4	5	C_c = 125 pF	0	10	I_{CM} = 7,5 A	length < 39.5	
n-p-n	f_T = 7 MHz	0.1	5	t_f = 0.7 μs			$-I_{CM}$ = 7,5 A	width < 26.6	
horizontal				at:			$-I_{BM}$ = 2.5 A	height < 9.5	
deflection				I_{CMnom} = 4.5 A			V_{CERM} = 1500 V	leads >11	
colour t.v.				$I_{B(end)nom}$ = 1.8 A			P_{tot} = 12.5 W	TO-3	
				L_B = 10 μH			T_j = 115°C		
							$R_{th\,j-mb}$ = 1.6°C/W		

BU105

BU108

DEFLECTION TRANSISTORS

Type and applications	*Characteristics at:*	I_C (A)	V_{CE} (V)	*Characteristics at:*	I_E (A)	V_{CB} (V)	*Ratings*	*Outlines (mm)*	
BU126 n-p-n switched mode power supply colour tv	I_{CES} < 0,5 mA h_{FE} 15-60 f_T = 8 MHz	– 1 0,2	750 5 10	C_c = 85 pF $V_{CE\,sat}$ < 10 V at t_f = 0,15 μs at	0 I_C = 2,5 A; I_B = 0,25 A I_{CM} = 2,5 A; $I_{B(end)}$ = 0,25 A	10	I_{CM} = 6 A $-I_{BM}$ = 1,5 A V_{CESM} = 750 V V_{CEO} = 300 V P_{tot} = 30 W T_j = 125°C $R_{th\,j-mb}$ = 2,5°C/W	length < 39,5 width < 26,6 height < 9,5 leads > 11 TO-3	BU126
BU132 n-p-n vertical deflection	I_{CES} < 0,25 h_{FE} 25-80 f_T = 8 MHz	– 0,25 0,1	800 10 10	$V_{CE\,sat}$ < 5 V at	I_C = 0,25 A; I_B = 25 mA		I_{CM} = 1 A V_{CESM} = 800 V V_{CEO} = 600 V P_{tot} = 15 W T_j = 135°C $R_{th\,j-mb}$ = 2,5°C/W	length < 39,5 width < 26,6 height < 9,5 leads > 11 TO-3	BU132
BU133 n-p-n general high voltage	h_{FE} 15-80 f_T = 8 MHz t_f = 0,5 μs	1 0,2 2,5	5 10 –	C_c = 8,5 pF $V_{CE\,sat}$ < 10 V at	I_C = 2,5 A; I_B = 0,25 A		I_C = 3 A I_{CM} = 6 A V_{CEO} = 250 V P_{tot} = 30 W T_j = 125°C $R_{th\,j-mb}$ = 2,5°C/W	length < 39,5 width < 26,6 height < 9,5 leads > 11	BU133

BU204 n-p-n horizontal deflection	I_{CES} < 1 mA h_{FE} > 2 f_T = 7,5 MHz	– 2 0,1	1300 5 5	C_c = 65 pF 0 10 V_{CEsat} < 5 V at I_C = 2 A; I_B = 1 A t_f = 0,75 μs at I_C = 2 A; $I_{B(end)}$ = 1 A L_B = 25 μH	I_{CM} = 3 A $-I_{BM}$ = 1,5 A V_{CESM} = 1300 V V_{CEO} = 600 V P_{tot} = 10 W T_j = 115°C $R_{th\,j-mb}$ = 2,5°C/W	length < 39,5 width < 26,6 height < 9,5 leads > 11 TO-3	 BU204
BU205	Equivalent to BU204 except for: I_{CES} < 1 mA	–	1500		V_{CESM} = 1500 V		
BU206	Equivalent to BU204 except for: I_{CES} < 1 mA	–	1700	V_{CEsat} < 5 V at I_C = 2 A; I_B = 1,1 A	V_{CESM} = 1700 V		
BU207 n-p-n horizontal f_T deflection colour tv	I_{CES} < 1 mA h_{FE} > 2,25 = 7 MHz	– 4,5 0,1	1300 5 5	C_c = 125 pF 0 10 V_{CEsat} < 5 V at I_C = 4,5 A; I_B = 2 A t_f = 0,9 μs at I_C = 4,5 A; $I_{B(end)}$ = 1,8 A L_B = 10 μH	I_{CM} = 7,5 A $-I_{BM}$ = 2,5 A V_{CESM} = 1300 V V_{CEO} = 600 V P_{tot} = 12,5 W T_j = 115°C $R_{th\,j-mb}$ = 1,6°C/W	length < 39,5 width < 26,6 height < 9,5 leads > 11 TO-3	 BU207
BU208	Equivalent to BU207 except for: I_{CES} < 1 mA	–	1500	t_f = 0,7 μs at I_C = 4,5 A; $I_{B(end)}$ = 1,8 A L_B = 10 μH	V_{CESM} = 1500 V V_{CEO} = 700 V		
BU209	Equivalent to BU207 except for: I_{CES} < 1 mA h_{FE} > 2,25	– 3	1700 5	V_{CEsat} < 5 V at I_C = 3 A; I_B = 1,3 A t_f = 0,7 μs at I_C = 3 A; $I_{B(end)}$ = 1,3 A L_B = 10 μH	V_{CESM} = 1700 V V_{CEO} = 800 V		

SWITCHING TRANSISTORS

Type and applications	*Characteristics at:*	I_C *(mA)*	V_{CE} *(V)*	I_E *(mA)*	V_{CB} *(V)*	*Characteristics at:*	I_C *(mA)*	I_B *(mA)*	*Ratings*	*Outlines (mm)*
ASY26	$-V_{BE} < 1.5$ V	−300	−1			$-V_{CE\,sat} < 0.25$ V	−50	−2	$-I_{CM} = 300$ mA	length < 6.6
p-n-p	$h_{FE} < 80$	−20	−1			$-V_{BE\,sat} < 0.55$ V	−50	−2.4	$-V_{CEO} = 15$ V	width < 8.5
general	$h_{FE} = 27$	−200	−1			$t_d < 90$ ns			$P_{tot} = 150$ mW	leads > 38
	$f_T = 8$ MHz	−3	−5			$t_r < 490$ ns			$T_j = 85°C$	
	$h_{fe} = 50$	−2	−5			$t_s < 1350$ ns			$R_{th\,j-a} = 0.4°C/mW$	
	$-I_{CBO} < 7$ μA			0	−30	$t_f < 730$ ns				
	$C_c < 16$ pF			0	−5					
ASY27	$-V_{BE} < 1.4$ V	−300	−1			$-V_{CE\,sat} < 0.25$ V	−50	−1.25	$-I_{CM} = 300$ mA	length < 6.6
p-n-p	$h_{FE} = <150$	−20	−1			$-V_{BE\,sat} < 0.45$ V	−50	−1.55	$-V_{CEO} = 15$ V	width < 8.5
general	$h_{FE} = 40$	−200	−1			$t_d < 75$ ns			$P_{tot} = 150$ W	leads > 38
	$f_T = 14$ MHz	−3	−5			$t_r < 350$ ns			$T_j = 85°C$	
	$h_{fe} = 90$	−2	−5			$t_s < 1500$ ns			$R_{th\,j-a} = 0.4°C/mW$	
	$-I_{BCO} < 7$ μA			0	−25	$t_f < 620$ ns				
	$C_c < 16$ pF			0	−5					
ASY28	$V_{BE} < 1.5$ V	300	1			$V_{CE\,sat} < 0.25$ V	50	2	$I_{CM} = 300$ mA	length < 6.6
n-p-n	$h_{FE} < 80$	20	1			$V_{BE\,sat} < 0.55$ V	50	2.4	$V_{CEO} = 15$ V	width < 8.5
general	$h_{FE} = 32$	200	1			$t_d < 90$ ns			$P_{tot} = 150$ mW	leads > 38
	$f_T = 14$ MHz	3	5			$t_r < 400$ ns			$T_j = 85°C$	
	$h_{fe} = 50$	2	5			$t_s < 700$ ns			$R_{th\,j-a} = 0.4°C/mW$	
	$I_{CBO} < 7$ μA			0	30	$t_f < 620$ ns				
	$C_c < 16$ pF			0	5					

ASY29	V_{BE} < 1.4 V	300	1		$V_{CE\,sat}$ < 0.25 V	50	1.25	I_{CM} = 300 mA	length < 6.6
n-p-n	h_{FE} < 150	20	1		$V_{BE\,sat}$ < 0.45 V	50	1.55	V_{CEO} = 15 V	width < 8.5
general	h_{FE} = 84	200	1		t_d < 75 ns			P_{tot} = 150 mW	leads > 38
	f_T = 20 MHz	3	5		t_r < 300 ns			T_j = 85°C	
	h_{fe} = 90	2	5		t_s < 800 ns			$R_{th\,j-a}$ = 0.4°C/mW	
	I_{CBO} < 7 μA			0 25	t_f < 520 ns				
	C_c < 16 pF			0 5					

ASY73	I_{CBO} < 3 μA			0 5	$V_{CE\,sat}$ < 0.30 V	200	10	I_C = 400 mA	length < 6.6
n-p-n	h_{FE} > 20			−200 0	$V_{BE\,sat}$ < 0.90 V	200	12	V_{CEO} = 15 V	width < 8.5
symmetrical	C_c < 30 pF			0 5				P_{tot} = 140 mW	leads > 38
	f_T > 4 MHz			−3 5				T_j = 75°C	
								$R_{th\,j-a}$ = 0.35°C/mW	

ASY74	I_{CBO} < 3 μA			0 5	$V_{CE\,sat}$ < 0.37 V	400	20	I_C = 400 mA	length < 6.6
n-p-n	h_{FE} > 20			−400 0	$V_{BE\,sat}$ < 0.70 V	200	7	V_{CEO} = 15 V	width < 8.5
symmetrical	C_c < 30 pF			0 5				P_{tot} = 140 mW	leads > 38
	f_T > 6 MHz			−3 5				T_j = 75°C	
								$R_{th\,j-a}$ = 0.35°C/mW	

ASY75	I_{CBO} < 3 μA			0 5	$V_{CE\,sat}$ < 0.37 V	400	13.5	I_C = 400 mA	length < 6.6
n-p-n	h_{FE} > 30			−400 0	$V_{CE\,sat}$ < 0.6 V	200	5	V_{CEO} = 15 V	width < 8.5
symmetrical	C_c < 30 pF			0 5				P_{tot} = 140 mW	leads > 38
	f_T > 10 MHz			−3 5				T_j = 75°C	
								$R_{th\,j-a}$ = 0.35°C/mW	

SWITCHING TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	I_E (mA)	V_{CB} (V)	Characteristics at:	I_C (mA)	I_B (mA)	Ratings	Outlines (mm)
ASY76	h_{FE} > 75	−10	−6			$-V_{CE\,sat}$ < 0.3 V	−300	−12	$-I_{CM}$ = 1 A	length < 6.6
p-n-p	h_{FE} < 130	−300	0						$-V_{CEX}$ = 32 V	width < 8.5
pulse-oscillator	f_T > 0.5 MHz	−10	−5						P_{tot} = 500 mW	leads > 38
	h_{fe} = 81	−25	−5						T_j = 85°C	
	$-I_{CBO}$ < 10 μA			0	−10				$R_{th\,j-a}$ = 0.25°C/mW	
	$-V_{BE}$ < 0.75 V			300	0					
	C_c < 60 pF			0	−5					
	F < 15 dB			0.5	−2					
ASY77	Equivalent to ASY76 except for								$-V_{CEX}$ = 60 V	
ASY80	f_T > 0.7 MHz	−10	−5			$-V_{CE\,sat}$ < 0.4 V	−300	−6	$-I_{CM}$ = 1 A	length < 6.6
p-n-p	h_{fe} = 96	−25	−5						$-V_{CEX}$ = 10 V	width < 8.5
pulse-oscillator	$-I_{CBO}$ < 10 μA			0	−10				P_{tot} = 500 mW	leads > 38
	$-V_{BE}$ < 0.75 V			300	0				T_j = 85°C	
	h_{FE} > 60			−50	0				$R_{th\,j-a}$ = 0.25°C/mW	
	h_{FE} > 50			−300	0					
	C_c < 60 pF			0	−5					
	F < 15 dB			0.5	−2					
ASZ21	h_{FE} > 30	−10	−0.5			$-V_{CE\,sat}$ < 1.1 V	−50	−3	$-I_{CM}$ = 50 mA	length < 5.3
p-n-p	h_{FE} > 50	−30	−1.0			$-V_{BE\,sat}$ < 0.75 V	−30	−0.9	$-V_{CEO}$ = 15 V	width < 4.8
fast	$-I_{CBO}$ < 3.5 μA			0	−0.5	t_d = 30 ns			P_{tot} = 120 mW	leads > 12.7
	C_c < 5 pF			0	−6	t_r = 20 ns			T_j = 85°C	
	f_T > 300 MHz			10	−2	t_r = 40 ns			$R_{th\,j-a}$ = 0.5°C/mW	
						t_f = 40 ns				

BCY30 to **34** See section: LOW FREQUENCY TRANSISTORS

BCY38 to **40** See section: LOW FREQUENCY TRANSISTORS

BCY54 See section: LOW FREQUENCY TRANSISTORS

BCY56 See section: LOW FREQUENCY TRANSISTORS

BCY57 See section: LOW FREQUENCY TRANSISTORS

BFX34
n-p-n
high current
switching
inverters

$h_{FE}=130$	1000	2		$V_{CE\,sat}<1$ V	5000	500
$h_{FE}=110$	2000	2		$V_{BE\,sat}<1.8$ V	5000	500
$f_T=100$ MHz	500	5		$t_{on}<0.6\ \mu$s	5000	± 500
$C_c<100$ pF			0 10	$t_{off}<1.2\ \mu$s	5000	± 500

$I_{CM}=5$ A
$V_{CEO}=60$ V
$P_{tot}=5$ W
$T_j=200°$C
$R_{th\,j-a}=200°$C/W

length <6.6
width <8.5
leads >12.7

BRY39 (SCS)
BRY39 (PUT) See section: MISCELLANEOUS TRANSISTORS

BSS27
n-p-n
core driver

$h_{FE}>30$	150	1		$V_{CE\,sat}<0.3$ V	150	10
$h_{FE}>25$	500	1		$V_{CE\,sat}<0.8$ V	1000	100
$h_{FE}>15$	1000	5		$V_{BE\,sat}<1.0$ V	150	10
$f_T=400$ MHz	50	10		$V_{BE\,sat}<1.5$ V	1000	100
$f_T=300$ MHz	500	10		$t_{on}<25$ ns	500	± 50
$C_c<8$ pF			0 10	$t_{on}<20$ ns	1000	± 100
				$t_{off}<40$ ns	500	± 50
				$t_{off}<40$ ns	1000	± 100
				$t_s>12$ ns	500	± 50
				$t_s>8$ ns	1000	± 100

$I_{CM}=1$ A
$V_{CEO}=45$ V
$P_{tot}=800$ mW
$T_j=200°$C
$R_{th\,j-a}=225°$C/W

length <6.6
width <8.5
leads >12.7

SWITCHING TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	I_E (*mA*)	V_{CB} (*V*)	*Characteristics at:*	I_C (*mA*)	I_B (*mA*)	*Ratings*	*Outlines (mm)*
BSS28	$h_{FE} > 40$	150	1			$V_{CE\,sat} < 0.3$ V	150	10	I_{CM} = 1 A	length < 6.6
n-p-n	$h_{FE} > 30$	500	1			$V_{CE\,sat} < 0.4$ V	500	35	V_{CEO} = 30 V	width < 8.5
core driver	f_T = 400 MHz	50	10			$V_{BE\,sat} < 1.0$ V	150	10	P_{tot} = 800 mW	leads > 12.7
	f_T = 300 MHz	500	10			$V_{BE\,sat} < 1.2$ V	500	35	T_j = 200°C	
	C_c < 8 pF			0	10	t_{on} < 25 ns	500	±50	$R_{th\,j-a}$ = 225°C/W	
						t_{off} < 45 ns	500	±50		
						t_s > 10 ns	500	±50		
BSS29	$h_{FE} > 25$	150	1			$V_{CE\,sat} < 0.4$ V	150	10	I_{CM} = 1 A	length < 6.6
n-p-n	$h_{FE} > 20$	500	1			$V_{CE\,sat} < 0.5$ V	500	35	V_{CEO} = 30 V	width < 8.5
core driver	f_T = 400 MHz	50	10			$V_{BE\,sat} < 1.0$ V	150	10	P_{tot} = 800 mW	leads > 12.7
	f_T = 300 MHz	500	10			$V_{BE\,sat} < 1.2$ V	500	35	T_j = 200°C	
	C_c < 8 pF			0	10	t_{on} < 30 ns	500	±50	$R_{th\,j-a}$ = 225°C/W	
						t_{off} < 50 ns	500	±50		
						t_s > 10 ns	500	±50		
BSS40	$h_{FE} > 30$	150	1			$V_{CE\,set} < 0{,}3$ V	150	10	I_{CM} = 1 A	length < 5,3
n-p-n	$h_{FE} > 25$	500	1			$V_{CE\,sat} < 0{,}5$ V	500	50	V_{CEO} = 40 V	width < 4,8
high speed	f_T > 200 MHz	50	10			$V_{BE\,sat} < 1{,}0$ V	150	10	P_{tot} = 360 mW	leads > 12,7
core-driving	C_c < 10 pF			0	10	$V_{BE\,sat} < 1{,}2$ V	500	50	T_j = 200°C	
purposes						t_{on} < 35 ns	500	±50	$R_{th\,j-a}$ = 480°C/W	
						t_{off} < 45 ns	500	±50		
BSS41	Equivalent to BSS40 except for:								V_{CEO} = 30 V	

BSV15	$h_{FE}(6) > 40$	-100	-1			$-V_{CE\,sat} < 1{,}0$ V	-500	-25	$-I_C = 1$A	length $< 6{,}6$
P-N-P	$h_{FE}(10) > 63$	-100	-1			$h_{fe} > 20$	-1	-5	$-V_{CEO} = 40$ V	width $< 8{,}5$
general	$h_{FE}(16) > 100$	-100	-1			$t_{on} < 500$ ns	-100	± 5	$P_{tot} = 5$ W	leads $> 12{,}7$
industrial	$f_T > 50$ MHz	-50	-10			$t_s < 500$ ns	-100	± 5	$T_j = 200°C$	
applications	$C_c < 30$ pF			0	-10	$t_f < 150$ ns	-100	± 5	$R_{th\,j-a} = 220°C$	

BSV16	Equivalent to BSV15 except for:	$-V_{CEO} = 60$ V

BSV17	Equivalent to BSV15 except for: $C_c < 25$ pF	$-V_{CEO} = 80$ V

BSV64	$h_{FE} > 40$	2000	2			$V_{CE\,sat} < 1.0$ V	5000	500	$I_{CM} = 5$ A	length < 6.6
n-p-n	$f_T = 100$ MHz	500	5			$V_{BE\,sat} < 1.8$ V	5000	500	$V_{CEO} = 60$ V	width < 8.5
print hammer	$I_{CBO} < 10\ \mu$A			0	60	$t_{on} < 6\ \mu$s	5000	± 500	$P_{tot} = 5$ W	leads > 12.7
driver	$C_c < 80$ pF			0	10	$t_{off} < 1.2\ \mu$s	5000	± 500	$T_j = 175°C$	
									$R_{th\,j-c} = 25°C/W$	

BSV68	$h_{FE} > 30$	-10	-5			$-V_{CE\,sat} < 250$ mV	-25	-2.5	$-I_{CM} = 100$ mA	length < 5.3
p-n-p	$h_{FE} > 30$	-25	-5			$-V_{BE\,sat} < 900$ mV	-25	-2.5	$-V_{CEO} = 100$ V	width < 4.8
driver for	$f_T = 95$ MHz	-25	-5						$P_{tot} = 250$ mW	leads > 12.7
indicator	$-I_{CBO} < 10\ \mu$A			0	-100				$T_j = 150°C$	
tubes	$C_c < 5$ pF			0	-10				$R_{th\,j-a} = 0.5°C/mW$	

SWITCHING TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	I_E (*mA*)	V_{CB} (*V*)	*Characteristics at:*	I_C (*mA*)	I_B (*mA*)	*Ratings*	*Outlines (mm)*
BSV86	$h_{FE} > 75$	10	10			$V_{CE\,sat} < 80$ mV	10	1	$I_{CM} = 1$ A	length < 7.62
n-p-n	$h_{FE} > 40$	500	10			$V_{CEsat} < 425$ mV	400	40	$V_{CEO} = 30$ V	width < 3.5
general	$h_{fe} > 50$	1	5			$V_{BE\,sat} < 1300$ mV	150	15	$P_{tot} = 220$ mW	height < 6.5
purposes	$h_{fe} > 70$	5	10			$V_{BE\,sat} < 1300$ mV	400	40	$T_j = 150°C$	leads > 2.3
	$f_T > 100$ MHz	50	10			$t_d = 20$ ns	150	±15	$R_{th\,j-a} = 450°C/W$	
	$I_{CBO} < 100$ nA			0	60	$t_r = 30$ ns	150	±15		
	$C_c < 25$ pF			0	10	$t_s = 190$ ns	150	±15		
						$t_f = 20$ ns	150	±15		
BSV87	Equivalent to BSV86 except for:									
	$h_{FE} > 35$	10	10							
	$h_{FE} > 20$	500	10							
	$h_{fe} > 40$	1	5							
	$h_{fe} > 35$	5	10							
BSV88	$h_{FE} > 35$	10	10			$V_{CE\,sat} < 80$ mV	10	1	$I_{CM} = 1$ A	length < 7.62
n-p-n	$h_{FE} > 20$	500	10			$V_{CE\,sat} < 425$ mV	400	40	$V_{CEO} = 25$ V	width < 2.5
general	$f_T > 100$ MHz	50	10			$V_{BE\,sat} < 1300$ mV	150	15	$P_{tot} = 220$ mW	height < 6.5
purposes	$I_{CBO} = 100$ nA			0	30	$V_{BE\,sat} < 1300$ mV	400	40	$T_j = 150°C$	leads > 2.3
	$C_c < 25$ pF			0	10	$t_d = 20$ ns	150	±15	$R_{th\,j-a} = 450°C/W$	
						$t_r = 30$ ns	150	±15		
						$t_s = 190$ ns	150	±15		
						$t_f = 20$ ns	150	±15		

BSV96	$h_{FE} > 25$	-10	-2			$-V_{CE\,sat} < 0.5$ V	-300	-30	$-I_{CM} = 800$ mA	length < 7.62
p-n-p	$h_{FE} > 25$	-500	-2			$-V_{CE\,sat} < 6$ V	-800	-30	$-V_{CEO} = 30$ V	width < 2.5
general	$h_{FE} > 100$	-150	-2			$-V_{BE\,sat} < 1.3$ V	-300	-30	$P_{tot} = 220$ mW	height < 6.5
purposes	$f_T = 75$ MHz	-50	-5						$T_j = 150$°C	leads > 2.3
	$C_c = 10$ pF			0	-10				$R_{th\,j-a} = 450$°C/W	

BSV97	Equivalent to BSV96 except for:									
	$h_{FE} > 40$	-150	-2							

BSV98	Equivalent to BSV96 except for:									
	$h_{FE} > 30$	-150	-2							

BSW41	$h_{FE} > 30$	10	10			$V_{CE\,sat} < 0.7$ V	500	35	$I_{CM} = 500$ mA	length < 5.3
n-p-n	$h_{FE} > 15$	500	1			$V_{BE\,sat} < 1.8$ V	500	50	$V_{CEO} = 25$ V	width < 4.8
driver	$f_T > 250$ MHz	50	10			$t_{on} < 60$ ns			$P_{tot} = 1$ W	leads > 12.7
	$I_{CBO} < 0.5$ µA			0	30	$t_{off} < 100$ ns			$T_j = 200$°C	
	$C_c < 8$ pF			0	10				$R_{th\,j-a} = 0{,}5$°C/mW	

BSW66	$h_{FE} > 30$	10	5			$V_{CE\,sat} < 0.4$ V	500	50	$I_{CM} = 2$ A	length < 6.6
n-p-n	$h_{FE} > 15$	1 A	5			$V_{BE\,sat} < 1.1$ V	500	50	$V_{CEO} = 100$ V	width < 8.5
general	$f_T = 80$ MHz	100	20			$t_{on} = 0.5$ µs			$P_{tot} = 0.8$ W	leads > 12.7
inductive load	$I_{CBO} < 100$ µA			0	100	$t_{off} = 1$ µs			$P_{tot} = 5$ W ($T_{case} = 25$°C)	
switching	$C_c < 35$ pF			0	10				$T_j = 200$°C	
									$R_{th\,j-a} = 220$°C/W	

BSW67	Equivalent to BSW66 except for:								$V_{CEO} = 120$ V	

BSW68	Equivalent to BSW66 except for:					$V_{CE\,sat} < 0.5$ V	500	50	$V_{CEO} = 150$ V	

SWITCHING TRANSISTORS

Type and applications	*Characteristics at:*	I_C (mA)	V_{CE} (V)	I_E (mA)	V_{CB} (V)	*Characteristics at:*	I_C (mA)	I_B (mA)	*Ratings*	*Outlines (mm)*
BSW69	$V_{BE} < 0.75$ V	4	2			$V_{CE\,sat} < 4$ V	20	1	$I_C = 50$ mA	length < 7.62
n-p-n	$h_{FE} > 30$	4	2						$V_{CER} = 150$ V	width < 2.5
driver	$f_T = 130$ MHz	10	5						$P_{tot} = 125$ mW	height < 6.5
	$I_{CBO} < 100$ nA			0	100				$T_j = 125$°C	leads > 2.3
	$I_{CBO} < 10$ μA			0	150				$R_{th\,j-a} = 0.6$°C/mW	
	$C_c = 2$ pF			0	10					
BSX12	$h_{FE} = 45$	10	0.5			$V_{CE\,sat} < 0.25$ V	10	1	$I_{CM} = 1$ A	length < 3.4
n-p-n	$h_{FE} = 65$	100	0.5			$V_{CE\,sat} < 0.23$ V	100	10	$V_{CE} = 12$ V	width < 8.5
very high	$h_{FE} = 60$	300	0.5			$V_{CE\,sat} < 0.33$ V	300	30	$P_{tot} = 3$ W	leads > 12.7
speed	$h_{FE} = 35$	1000	1.0			$V_{BE\,sat} < 0.78$ V	10	1	$T_j = 200$°C	TO-39-
	$f_T = 620$ MHz	100	5.0			$V_{BE\,sat} < 1.1$ V	100	10	$R_{th\,j-a} = 300$°C/W	reduced
	$f_T = 400$ MHz	500	—	—	0	$V_{BE\,sat} < 1.2$ V	300	30		height
	$I_{CBO} < 500$ μA			0	25	$t_{on} < 15$ ns	1000	±100		
	$C_c < 25$ pF			0	0	$t_s < 18$ ns	1000	±100		
	$C_c < 12$ pF			0	5	$t_{off} < 25$ ns	1000	±100		
BSX12A	Equivalent to BSX12 except for:								$V_{CEO} = 15$ V	
BSX19	$V_{BE} = 0.8$ V	10	1			$V_{CE\,sat} < 0.25$	10	1	$I_{CM} = 500$ mA	length < 5.3
n-p-n	$h_{FE} < 60$	10	1			$V_{BE\,sat} < 0.85$	10	1	$V_{CEO} = 15$ V	width < 4.8
fast	$h_{FE} > 10$	100	2			$t_s < 10$ ns			$P_{tot} = 360$ mW	leads > 12.7
	$f_T = 500$ MHz	10	10						$T_j = 200$°C	
	$I_{CBO} < 400$ nA			0	20				$R_{th\,j-a} = 0.48$°C/mW	
	$C_c < 4$ pF			0	5					

BSX20 Equivalent to BSX19 except for: $t_s < 13$ ns

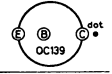
	$h_{FE} < 120$	10	1							
	$h_{FE} > 20$	100	2							
	$f_T = 600$ MHz	10	10							

BSX21	$h_{FE} = 82$	10	1			$V_{CE\,sat} = < 0.7$ V	4	0.4	I_{CM} = 250 mA	length < 5.3
n-p-n	$h_{FE} = 55$	20	1			$V_{BE\,sat} = < 1.2$ V	4	0.4	V_{CEO} = 80 V	width < 4.8
driver	$f_T = 160$ MHz	4	10						P_{tot} = 300 mW	leads > 12.7
	$I_{CBO} < 50\ \mu$A			0	90				T_j = 175°C	
	$C_c = 3.4$ pF			0	10				$R_{th\,j-a}$ = 0.5°C/mW	

BSX59	$h_{FE} > 30$	500	1						I_{CM} = 1 A	length < 6.6
n-p-n	$h_{FE} < 90$	500	1						V_{CEO} = 45 V	width < 8.5
high-speed	$f_T = 450$ MHz	50	10						P_{tot} = 0.8 V	leads > 38.0
core driver	$I_{CBO} < 500$ nA			0	40				T_j = 200°C	
	$C_c < 10$ pF			0	10				$R_{th\,j-a}$ = 220°C/W	

BSX60	$h_{FE} > 30$	500	1						I_{CM} = 1 A	length < 6.6
n-p-n	$h_{FE} < 90$	500	1						V_{CEO} = 30 V	width < 8.5
high-speed	$f_T = 475$	50	10						P_{tot} = 0.8 W	leads > 38.0
core driver	$I_{CBO} < 500$ nA			0	40				T_j = 200°C	
	$C_c < 10$ pF			0	10				$R_{th\,j-a}$ = 220°C/W	

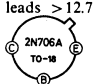
SWITCHING TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	I_E (*mA*)	V_{CB} (*V*)	*Characteristics at:*	I_C (*mA*)	I_B (*mA*)	*Ratings*	*Outlines (mm)*
BSX61	$h_{FE} > 30$	500	1						$I_{CM} = 1$ A	length < 6.6
n-p-n	$h_{FE} < 90$	500	1						$V_{CEO} = 45$ V	width < 8.5
high-speed	$f_T = 475$ MHz	50	10						$P_{tot} = 0.8$ W	leads > 38.0
core driver	$I_{CBO} < 500$ nA			0	40				$T_j = 200$°C	
	$C_c < 10$ pF			0	10				$R_{th\,j-a} = 220$°C/W	
BSY38	$h_{FE} < 60$	10	0.35			$V_{CE\,sat} < 0.6$ V	100	10	$I_{CM} = 200$ mA	length < 5.3
n-p-n	$h_{FE} < 45$	100	1			$V_{BE\,sat} < 1.5$ V	100	10	$V_{CEX} = 15$ V	width < 4.8
very	$f_T = 350$ MHz	10	2			$t_{on} < 14$ ns			$P_{tot} = 300$ mW	leads > 12.7
high-speed	$I_{CBO} < 100$ nA			0	20	$t_{off} < 45$ ns			$T_j = 175$°C	
	$-V_{EB} = 0.95$ V			−100	0				$R_{th\,j-a} = 0.5$°C/mW	
	$C_c < 5$ pF			0	5					
BSY39	Equivalent to BSY38 except for:									
	$h_{FE} < 120$	10	0.35							
	$h_{FE} < 70$	100	1							
OC139	$f_T = 6$ MHz	3	5			$V_{CE\,sat} < 0.22$ V	50	3.1	$I_C = 250$ mA	length < 15
n-p-n	$I_{CBO} < 3$ μA			0	5	$V_{BE\,sat} < 0.5$ V	50	3.1	$V_{CEX} = 20$ V	width < 5.2
symmetrical	$h_{FE} < 84$			−15	0				$P_{tot} = 145$ mW	leads > 37
high-speed	$h_{FE} > 15$			−200	0				$T_j = 75$°C	
									$R_{th\,j-a} = 0.35$°C/mW	

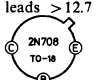
OC140	f_T = 12 MHz	3	5		$V_{CE\,sat}$ < 0.37 V	400	20	I_C	= 400 mA	length < 15
n-p-n	I_{CBO} < 3 μA			0 5	$V_{BE\,sat}$ < 0.90 V	400	20	V_{CEX}	= 20 V	width < 5.2
symmetrical	h_{FE} < 150			−15 0				P_{tot}	= 145 mW	leads > 37
high-speed	h_{FE} < 67			−200 0				T_j	= 75°C	
								$R_{th\,j-a}$	= 0.35°C/mW	

OC141	f_T = 20 MHz	3	5		$V_{CE\,sat}$ < 0.37 V	400	13.3	I_C	= 400 mA	length < 15
n-p-n	I_{CBO} < 3 μA			0 5	$V_{BE\,sat}$ < 0.70 V	400	20	V_{CEX}	= 20 V	width < 5.2
symmetrical	h_{FE} < 200			−15 0				P_{tot}	= 145 mW	leads > 37
high-speed	h_{FE} < 134			−200 0				T_j	= 75°C	
								$R_{th\,j-a}$	= 0.35°C/mW	

2N706A	h_{FE} < 60	10	1		$V_{CE\,sat}$ < 0.6 V	10	1	I_C	= 50 mA	length < 5.3
n-p-n	f_T > 200 MHz	10	10		$V_{BE\,sat}$ < 0.9 V	10	1	V_{CEO}	= 15 V	width < 4.8
high-speed	I_{CBO} < 10 μA			0 25	t_{on} < 40 ns			P_{tot}	= 300 mW	leads > 12.7
	C_c < 5 pF			0 5	t_{off} < 75 ns			T_j	= 175°C	
								$R_{th\,j-a}$	= 0.5°C/mW	



2N708	h_{FE} > 15	0.5	1		$V_{CE\,sat}$ < 0.4 V	10	1	I_{CM}	= 500 mA	length < 5.3
n-p-n	h_{FE} < 120	10	1		$V_{BE\,sat}$ < 0.8 V	10	1	V_{CEO}	= 15 V	width < 4.8
very	f_T > 300	10	10		t_s < 25 ns			P_{tot}	= 360 mW	leads > 12.7
high-speed	I_{CBO} < 25 nA			0 20				T_j	= 200°C	
	C_c < 6 pF			0 10				$R_{th\,j-a}$	= 0.48°C/mW	



SWITCHING TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	I_E (mA)	V_{CB} (V)	Characteristics at:	I_C (mA)	I_B (mA)	Ratings	Outlines (mm)
2N743	$h_{FE} > 10$	1	0.25			$V_{CE\,sat} < 1$ V	100	10	I_C = 200 mA	length < 5.3
n-p-n	$h_{FE} > 20$	10	0.35			$V_{BE\,sat} < 1.5$ V	100	10	V_{CEO} = 12 V	width < 4.8
very	$h_{FE} > 10$	100	1			$t_s < 14$ ns			P_{tot} = 300 mW	leads > 12.7
high-speed	$f_T > 300$ MHz	10	10						T_j = 175°C	
	$I_{CBO} < 1$ μA			0	20				$R_{th\,j-a}$ = 0.5°C/mW	
	C_c < 5 pF			0	5					
2N744	Equivalent to 2N743 except for:									
	$h_{FE} > 20$	1	0.25			$t_s < 18$ ns				
	$h_{FE} > 40$	10	0.35							
	$h_{FE} > 20$	100	1							
2N753	Equivalent to 2N706A except for:									
	$h_{FE} < 120$	10	1							
2N914	$h_{FE} > 30$	10	1			$V_{CE\,sat} < 0.7$ V	200	20	I_{CM} = 500 mA	length < 5.3
n-p-n	$h_{FE} > 10$	500	5			$V_{BE\,sat} < 0.8$ V	10	1	V_{CEO} = 15 V	width < 4.8
very	$f_T > 300$ MHz	20	10			$t_{on} < 40$ ns			P_{tot} = 360 mW	leads > 12.7
high-speed	$I_{CBO} < 25$ nA			0	20	$t_{off} < 40$ ns			T_j = 200°C	
	C_c < 6 pF			0	10				$R_{th\,j-a}$ = 0.48°C/mW	

2N1131	h_{FE}	<45	−150	−10			$-V_{CE\,sat}$	<1.5 V	−150	−15	$-I_C$ = 0.6 A
p-n-p	f_T	>50 MHz	−50	−10			$-V_{BE\,sat}$	<1.3 V	−150	−15	$-V_{CEO}$ = 35 V
high-speed	h_{fe}	<50	−1	−5							P_{tot} = 2 W
	h_{fe}	>20	−5	−10							T_j = 175°C
	$-I_{CBO}$	<1 μA			0	−30					$R_{th\,j-a}$ = 250°C/W
	C_c	<45 pF			0	−10					

length <6.6
width <8.5
leads >38

2N1132	h_{FE}	<90	−150	−10			$-V_{CE\,sat}$	<1.5 V	−150	−15	$-I_C$ = 0.6 A
p-n-p	f_T	>60 MHz	−50	−10			$-V_{BE\,sat}$	<1.3 V	−150	−15	$-V_{CEO}$ = 35 V
high-speed	h_{fe}	<100	−1	−5							P_{tot} = 2 W
	h_{fe}	>30	−5	−10							T_j = 175°C
	$-I_{CBO}$	<1 mA			0	−30					$R_{th\,j-a}$ = 250°C/W
	C_c	<45 pF			0	−10					

length <6.6
width <8.5
leads >38

2N1302	h_{FE}	= 48	200	0.35			$V_{CE\,sat}$	<2.2 V	10	0.5	I_{CM} = 300 mA
n-p-n	f_T	= 10 MHz	1	5			$V_{BE\,sat}$	<0.4 V	10	0.5	V_{CEO} = 25 V
medium	I_{CBO}	<6 μA			0	25	t_d	= 65 ns			P_{tot} = 150 mW
speed	C_c	<20 pF			0	5	t_r	= 220 ns			T_j = 85°C
							t_s	= 500 ns			$R_{th\,j-a}$ = 0.4°C/mW
							t_f	= 365 ns			

length <6.6
width <8.5
leads >38

2N1303	h_{FE}	= 35	−200	−0.35			$-V_{CE\,sat}$	<0.2 V	−10	−0.5	$-I_{CM}$ = 300 mA
p-n-p	f_T	= 5 MHz	−1	−5			$-V_{BE\,sat}$	<0.4 V	−10	−0.5	$-V_{CEO}$ = 25 V
medium	$-I_{CBO}$	<6 μA			0	−25	t_d	= 60 ns			P_{tot} = 150 mW
speed	C_c	<20 pF			0	−5	t_r	= 300 ns			T_j = 85°C
							t_s	= 700 ns			$R_{th\,j-a}$ = 0.4°C/mW
							t_f	= 600 ns			

length <6.6
width <8.5
leads >38

SWITCHING TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	I_E (mA)	V_{CB} (V)	Characteristics at:	I_C (mA)	I_B (mA)	Ratings	Outlines (mm)
2N1304	Equivalent to 2N1302 except for:									
	$h_{FE}=65$	200	0.35			$V_{CE\,sat}<0.2$ V	10	0.25		
	$f_T=15$ MHz	1	5			$V_{BE\,sat}<0.35$ V	10	0.5		
						$t_d=60$ ns				
						$t_r=210$ ns				
						$t_f=350$ ns				
2N1305	Equivalent to 2N1303 except for:									
	$h_{FE}=55$	−200	−0.35			$-V_{CE\,sat}<0.2$ V	−10	−0.25		
	$f_T=10$ MHz	−1	−5			$-V_{BE\,sat}<0.35$ V	−10	−0.5		
						$t_d=55$ ns				
						$t_r=200$ ns				
						$t_f=450$ ns				
2N1306	Equivalent to 2N1302 except for:									
	$h_{FE}=95$	200	0.35			$V_{CE\,sat}<0.2$ V	10	0.17		
	$f_T=20$ MHz	1	5			$V_{BE\,sat}<0.35$ V	10	0.5		
						$t_d=55$ ns				
						$t_r=170$ ns				
						$t_f=315$ ns				
2N1307	Equivalent to 2N1303 except for:									
	$h_{FE}=90$	−200	−0.35			$-V_{CE\,sat}<0.2$ V	−10	−0.17		
	$f_T=15$ MHz	−1	−5			$-V_{BE\,sat}<0.35$ V	−10	−0.5		
						$t_d=50$ ns				
						$t_r=180$ ns				
						$t_f=350$ ns				

2N1308 Equivalent to 2N1302 except for:

$h_{FE} = 145$	200	0.35	$V_{CE\,sat} < 0.2$ V	10	0.13
$f_T = 30$ MHz	1	5	$V_{BE\,sat} < 0.35$ V	10	0.5
			$t_d = 55$ ns		
			$t_r = 165$ ns		
			$t_f = 290$ ns		

2N1309 Equivalent to 2N1303 except for:

$h_{FE} = 130$	−200	−0.35	$-V_{CE\,sat} < 0.2$ V	−10	−0.13
$f_T = 20$ MHz	−1	−5	$-V_{BE\,sat} < 0.35$ V	−10	−0.5
			$t_d = 45$ ns		
			$t_r = 155$ ns		
			$t_f = 350$ ns		

2N2218
n-p-n
high-speed

$h_{FE} > 25$	1	10			$V_{CE\,sat} < 1.6$ V	500	50	$I_C = 0.8$ A
$h_{FE} > 40$	150	10			$V_{BE\,sat} < 2.6$ V	500	50	$V_{CEO} = 30$ V
$h_{FE} > 20$	500	10						$P_{tot} = 0.8$ W
$f_T > 250$ MHz	20	20						$T_j = 75$°C
$I_{CBO} < 10$ nA			0	50				$R_{th\,j-a} = 190$°C/W
$C_c < 8$ pF			0	10				

length < 6.6
width < 8.5
leads > 38

2N2218A
n-p-n
high-speed

$h_{FE} > 25$	1	10			$V_{CE\,sat} < 1.0$ V	500	50	$I_C = 0.8$ A
$h_{FE} > 40$	150	10			$V_{BE\,sat} < 2.0$ V	500	50	$V_{CEO} = 40$ V
$h_{FE} > 25$	500	10						$P_{tot} = 0.8$ W
$f_T > 250$ MHz	20	20						$T_j = 175$°C
$I_{CBO} < 10$ nA			0	60				$R_{th\,j-a} = 190$°C/W
$C_c < 8$ pF			0	10				

length < 6.6
width < 8.5
leads > 38

SWITCHING TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	I_E (mA)	V_{CB} (V)	Characteristics at:	I_C (mA)	I_B (mA)	Ratings	Outlines (mm)
2N2219	Equivalent to 2N2218 except for:									
	$h_{FE} > 50$	1	10							
	$h_{FE} > 100$	150	10							
	$h_{FE} > 30$	500	10							
2N2219A	Equivalent to 2N2218A except for:									
	$h_{FE} > 50$	1	10							
	$h_{FE} > 100$	150	10							
	$h_{FE} > 40$	500	10							
	$f_T = 300$ MHz	20	20							
2N2221	Equivalent to 2N2218 except for:								$P_{tot} = 0.5$ W $R_{th\,j-a} = 300$°C/W	length < 5.3 width < 4.8 leads > 12.7
2N2221A	Equivalent to 2N2218A except for:								$P_{tot} = 0.5$ W $R_{th\,j-a} = 300$°C/W	length < 5.3 width < 4.8 leads > 12.7

2N2222 Equivalent to 2N2218 except for:

h_{FE} > 50	1	10
h_{FE} > 100	150	10
h_{FE} > 30	500	10

P_{tot} = 0.5 W
$R_{th\,j-a}$ = 300°C/W

length < 5.3
width < 4.8
leads > 12.7

2N2222A Equivalent to 2N2218A except for:

h_{FE} > 50	1	10
h_{FE} > 100	150	10
h_{FE} > 40	500	10
f_T > 300 MHz	20	20

P_{tot} = 0.5 W
$R_{th\,j-a}$ = 300°C/W

length < 5.3
width < 4.8
leads > 12.7

2N2368 n-p-n very high-speed

h_{FE} > 10	100	2			$V_{CE\,sat}$ < 0.25 V	10	1
f_T > 400 MHz	10	10			$V_{BE\,sat}$ < 0.85 V	10	1
I_{CBO} < 0.4 μA			0	20	t_s < 10 ns		
C_c < 4 pF			0	5	t_{off} < 15 ns		

I_{CM} = 500 mA
V_{CEO} = 15 V
P_{tot} = 360 mW
T_j = 200°C
$R_{th\,j-a}$ = 0.48°C/mW

length < 5.3
width < 4.8
leads > 12.7

2N2369 Equivalent to 2N2368 except for:

h_{FE} > 20	100	2
f_T > 500 MHz	10	10

t_s < 13 ns
t_{off} < 18 ns

SWITCHING TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	$-I_E$ (*mA*)	V_{CB} (*V*)	*Characteristics at:*	I_C (*mA*)	I_B (*mA*)	*Ratings*	*Outlines (mm)*
2N2369A	$h_{FE} > 30$	30	0.4			$V_{CE\,sat} < 0.5$ V	100	10	$I_{CM} = 500$ mA	length < 5.3
n-p-n	$h_{FE} > 20$	100	1			$V_{BE\,sat} < 1.6$ V	100	10	$V_{CEO} = 15$ V	width < 4.8
very	$f_T > 500$ MHz	10	10			$t_s = 13$ ns			$P_{tot} = 360$ mW	leads > 12.7
high-speed	$C_c < 4$ pF			0	5	$t_{off} = 18$ ns			$T_j = 200°C$	
									$R_{th\,j-a} = 0.48°C/mW$	
2N2894	$h_{FE} > 30$	−10	−0.3			$-V_{CE\,sat} < 0.15$ V	−10	−1	$-I_C = 200$ mA	length < 5.3
p-n-p	$h_{FE} > 17$	−30	−0.5			$-V_{CE\,sat} < 0.2$ V	−30	−3	$-V_{CEO} = 12$ V	width < 4.8
medium speed	$h_{FE} > 25$	−100	−1.0			$-V_{CE\,sat} < 0.5$ V	−100	−10	$P_{tot} = 0.36$ W	leads > 12.7
	$h_{fe} > 4.0$	−30	−10			$-V_{BE\,sat} < 0.98$ V	−10	−1	at $T_{amb} = 25°C$	
	$-I_{CBO} < 10\ \mu A$			0	−6	$-V_{BE\,sat} < 1.2$ V	−30	−3.0	$P_{tot} = 1.2$ W	
	$C_c < 6$ pF			0	−5	$-V_{BE\,sat} < 1.7$ V	−100	−10	at $T_{case} = 25°C$	
						$t_{on} < 60$ ns	−30	±1.5	$T_j = 200°C$	
						$t_{off} < 90$ ns	−30	±1.5	$R_{th\,j-a} = 486°C/W$	
2N2894A	$h_{FE} > 30$	−10	−0.3			$-V_{CE\,sat} < 0.13$ V	−10	−1	$-I_C = 200$ mA	length < 5.3
p-n-p	$h_{FE} > 20$	−30	−0.5			$-V_{CE\,sat} < 0.19$ V	−30	−3	$-V_{CEO} = 12$ V	width < 4.8
high speed	$h_{FE} > 30$	−100	−1.0			$-V_{CE\,sat} < 0.45$ V	−100	−10	$P_{tot} = 0.36$ W	leads > 12.7
	$h_{fe} > 8.0$	−30	−10			$-V_{BE\,sat} < 0.92$ V	−10	−1.0	at $T_{amb} = 25°C$	
	$-I_{CBO} = 10\ \mu A$			0	−10	$-V_{BE\,sat} < 1.15$ V	−30	−3.0	$P_{tot} = 1.2$ W	
	$C_c < 4.5$ pF			0	−5	$-V_{BE\,sat} < 1.5$ V	−100	−10	at $T_{case} = 25°C$	
						$t_{on} < 60$ ns	−30	±1.5	$T_j = 200°C$	
						$t_{off} < 35$ ns	−30	±1.5	$R_{th\,j-a} = 486°C/W$	

2N2904	h_{FE}	>35	−10	−10			$-V_{CE\,sat}$	<1.6 V	−500	−50	$-I_C$	=0.6 A
p-n-p	h_{FE}	>40	−150	−10			$-V_{BE\,sat}$	<2.6 V	−500	−50	$-V_{CEO}$	=40 V
driver	h_{FE}	>20	−500	−10			t_d	<10 ns			P_{tot}	=3 W
	f_T	>200 MHz	−50	−20			t_r	<40 ns			T_j	=200°C
	$-I_{CBO}$	<20 nA			0	−50	t_s	<80 ns			$R_{th\,j-a}$	=290°C/W
	C_c	<8 pF			0	−10	t_f	<30 ns				

length <6.6
width <8.5
leads >38

2N2904A	Equivalent to 2N2904 except for:					
	h_{FE}	>40	−10	−10		
	h_{FE}	>40	−500	−10		
	$-I_{CBO}$	<10 nA			0	−50

$-V_{CEO}$ =60 V

2N2905	Equivalent to 2N2904 except for:					
	h_{FE}	>75	−10	−10		
	h_{FE}	>100	−150	−10		
	h_{FE}	>30	−500	−10		

2N2905A	Equivalent to 2N2904 except for:					
	h_{FE}	>100	−10	−10		
	h_{FE}	>100	−150	−10		
	h_{FE}	>50	−500	−10		
	$-I_{CBO}$	<10 nA			0	−50

$-V_{CEO}$ =60 V

2N2906	h_{FE}	>20	−0.1	−10			$-V_{CE\,sat}$	<1.6 V	−500	−50	$-I_C$	=0.6 A
p-n-p	h_{FE}	>35	−10	−10			$-V_{BE\,sat}$	<2.6 V	−500	−50	$-V_{CEO}$	=40 V
driver	h_{FE}	>20	−500	−10			t_d	<10 ns			P_{tot}	=1.8 W
	f_T	>200 MHz	−50	−20			t_r	<40 ns			T_j	=200°C
	$-I_{CBO}$	<20			0	−50	t_s	<80 ns			$R_{th\,j-a}$	=97°C/W
	C_c	<8 pF			0	−10	t_f	<30 ns				

length <5.3
width <4.8
leads >12.7

SWITCHING TRANSISTORS

Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	I_E (mA)	V_{CB} (V)	Characteristics at:	I_C (mA)	I_B (mA)	Ratings	Outlines (mm)
2N2906A	Equivalent to 2N2906 except for:								$-V_{CEO}=60$ V	
	$h_{FE}>40$	-0.1	-10							
	$h_{FE}>40$	-10	-10							
	$h_{FE}>40$	-500	-10							
	$-I_{CBO}<10$ nA			0	-50					
2N2907 p-n-p driver	h_{FE} >35	-0.1	-10			$-V_{CE\,sat}<1.6$	-500	-50	$-I_C$ =0.6 A	length <5.3
	h_{FE} >75	-10	-10			$-V_{BE\,sat}<2.6$	-500	-50	$-V_{CEO}=40$ V	width <4.8
	h_{FE} >30	-500	-10						P_{tot} =0.4 W	leads >12.7
	f_T >200 MHz	-50	-20						T_j =200°C	
	$-I_{CBO}<20$ nA			0	-50				$R_{th\,j-a}$ =438°C/W	
	C_c <8 pF			0	-10					
2N2907A	Equivalent to 2N2907 except for:								$-V_{CEO}=60$ V	
	h_{FE} >75	-0.1	-10							
	h_{FE} >100	-10	-10							
	h_{FE} >50	-500	-10							
	$-I_{CBO}<10$ nA			0	-50					
2N3133 p-n-p high-speed	h_{FE} >25	-1	-10			$-V_{CE\,sat}<0.6$ V	-150	-15	$-I_C$ =0.6 A	length <6.6
	h_{FE} >10	-150	-1			$-V_{BE\,sat}<1.5$ V	-150	-15	$-V_{CEO}=35$ V	width <8.5
	h_{FE} >40	-150	-10			$t_{on}<75$ ns			P_{tot} =3 W	leads >38
	f_T >200 MHz	-50	-20			$t_{off}<150$ ns			T_j =200°C	
	$-I_{CBO}<50$ nA			0	-30				$R_{th\,j-a}$ =290°C/W	
	C_c <10 pF			0	-10					

2N3134 Equivalent to 2N3133 except for:

$h_{FE} > 50$	-1	-10
$h_{FE} > 25$	-150	-1
$h_{FE} > 100$	-150	-10

2N3303 n-p-n high speed

$h_{FE} > 20$	10	0.5
$h_{FE} > 30$	100	0.5
$h_{FE} > 30$	300	0.5
$f_T > 450$ MHz	100	5.0
$C_c < 15$ pF	0	5

$V_{CE\,sat} < 0.25$ V	10	1
$V_{CE\,sat} < 0.23$ V	100	10
$V_{CE\,sat} < 0.33$ V	300	30
$V_{BE\,sat} < 0.78$ V	10	1
$V_{BE\,sat} < 1.10$ V	100	10
$V_{BE\,sat} < 1.30$ V	300	30
$t_{on} < 15$ ns	1000	± 100
$t_{off} < 25$ ns	1000	± 1000
$t_s < 15$ ns	100	± 100

$I_C = 1$ A
$V_{CEO} = 12$ V
$P_{tot} = 0.6$ W at $T_{amb} = 25°C$
$P_{tot} = 3$ W at $T_{case} = 25°C$
$T_j = 200°C$
$R_{th\,j-a} = 290°C/W$

length < 3.4
width < 8.5
leads > 12.7

2N3426 Equivalent to 2N3303 except for:

$f_T > 200$ MHz	500	—	—	0
$C_c < 25$ pF			0	0

$t_d < 5$ ns	1000	± 100
$t_r < 15$ ns	1000	± 100
$t_s < 20$ ns	1000	± 100
$t_f < 15$ ns	1000	± 100

2N4036 p-n-p general purposes

$h_{FE} > 20$	-0.1	-10
$h_{FE} > 40$	-150	-10
$h_{FE} > 20$	-150	-2
$h_{FE} > 20$	-500	-10
$f_T > 60$ MHz	-50	-10
$C_c < 30$ pF	0	-10

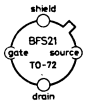
$-V_{CE\,sat} < 0.65$ V	-150	-15
$-V_{BE\,sat} < 1.4$ V	-150	-15
$t_r < 70$ ns	-150	± 15
$t_{on} < 110$ ns	-150	± 15
$t_s < 600$ ns	-150	± 15
$t_f < 100$ ns	-150	± 15
$t_{off} < 700$ ns	-150	± 15

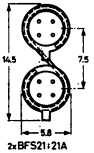
$-I_C = 1$ A
$-V_{CEO} = 65$ V
$P_{tot} = 5$ W
$T_j = 200°C$
$R_{th\,j-c} = 35°C/W$

length < 6.6
width < 8.5
leads > 12.7

FIELD EFFECT TRANSISTORS

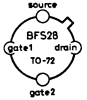
Type and applications	*Characteristics at:*	V_{DS} (V)	V_{GS} (V)	*Characteristics at:*	I_D (mA)	V_{DS} (V)	*Ratings*	*Outlines (mm)*	
BF245A	I_{DSS} < 6,5 mA	15	0	$-V_{GS}$ < 2,2 V	0,2	15	I_D = 25 mA	length < 5,2	TO-92
n-channel	F = 1,5 dB	15	0	$-V_{(P)GS}$ < 8,0 V	10 nA	15	$\pm V_{DS}$ = 30 V	width < 4,8	variant
l.f. and d.c.	f_{afs} = 700 MHz	15	0				P_{tot} = 300 mW	leads > 12,7	
amplifiers	$\|y_{fs}\|$ > 3,0 mA/V	15	0				T_j = 150°C		
h.f. amplifiers	$\|y_{fs}\|$ < 6,5 mA/V	15	0				$R_{th\,j-a}$ = 0,25°C/mW		
BF245B	equivalent to BF245A except for:								
	I_{DSS} < 15,0 mA	15	6	$-V_{GS}$ < 3,8 V	0,2	15			
BF245C	equivalent to BF245A except for:								
	I_{DSS} < 25 mA	15	0	$-V_{GS}$ < 7,5 V	0,2	15			
BFR29	I_{DSS} < 40 mA	15	0	$-V_{GS}$ < 3.5 V	0.1 μA	15	I_D = 20 mA	length < 5.3	
n-channel	$-I_{GSS}$ < 10 pA	0	−10	$-V_{(P)GS}$ < 4 V	0.1 μA	15	I_{DM} = 50 mA	width < 4.8	
depletion type	I_{GSS} < 10 pA	0	10	$\|y_{fs}\|$ > 6 mA/V	5	15	V_{DB} = 30 V	leads > 12.7	
audio, i.f.	$-C_{rs}$ = 0.5 pF	5	−1	C_{rs} < 0.7 pF	5	15	$\pm V_{GB}$ = 10 V		
v.h.f.				F < 5 dB	5	15	P_{tot} = 200 mW		
							T_j = 125°C		
							$R_{th\,j-a}$ = 0.5°C/mW		

BFS21; **BFS21A** individual transistor n-channel differential ampl.	$I_{DSS} > 1$ mA	15	0	$I_G < 0{,}5$ nA	0.5	15	I_D = 20 mA	length < 5.3	
				$-V_{(P)GS} < 6$ V	0.5	15	I_G = 10 mA	width < 4.8	
				$g_{fs} > 1.0$ mΩ^{-1}	0.5	15	$\pm V_{DS}$ = 30 V	leads > 12.7	
				$C_{rs} < 0.75$ pF	0.5	15	V_{DGO} = 30 V		
							$-V_{GSO}$ = 30 V		
							P_{tot} = 300 mW		
							T_j = 200°C		
							$R_{th\,j-a}$ = 0.59°C/mW		

BFS21; **BFS21A** matched pair in metal S-clip	$\frac{I_{D1-S1S}}{I_{D2-S2S}} < 1.05$	15	0	*Characteristics at:*	I_D (mA)	V_{DG} (V)	I_D = 4 mA I_G = 0.5 mA voltage between any two terminals V = 30 V P_{tot} = 30 mW T_{amb} = −20 to +100°C	
				BFS21:				
				$\Delta V_{GS} < 20$ mV	0.1	15		
				$\frac{d\,\Delta V_{GS}}{dT} < 75$ μV/°C	0.1	15		
				$\Delta \frac{1}{g_{fs}} < 75$ Ω	0.1	15		
				$CMRR > 60$ dB	0.1	15		
				BFS21A:				
				$\Delta V_{GS} < 10$ mV	0.1	15		
				$\frac{d\,\Delta V_{GS}}{dT} < 40$ μV/°C	0.1	15		
				$\Delta \frac{1}{g_{fs}} < 37.5$ Ω	0.1	15		
				$CMRR > 66$ dB	0.1	15		

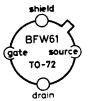
FIELD EFFECT TRANSISTORS

Type and applications	*Characteristics at:*	V_{DS} (V)	V_{GS} (V)	*Characteristics at:*	I_D (mA)	V_{DS} (V)	*Ratings*	*Outlines (mm)*
BFS28	$\pm I_{G1\text{-}SS} < 1$ nA	0	8	$\lvert y_{fs}\rvert > 8$ mΩ^{-1}	10	13	$I_D = 20$ mA	length < 5.3
depletion type	$\pm I_{G2\text{-}SS} < 1$ nA	0	8	$-C_{rs} = 25$ fF	10	13	$\pm V_{G1\text{-}S} = 8$ V	width < 4.8
communication				$F_{min} = 3$ dB	10	13	$\pm V_{G2\text{-}S} = 8$ V	leads > 12.7
instrumentation				$G_{tr} = 18$ dB	10	13	$P_{tot} = 200$ mW	
control				$G_{UM} = 21$ dB	10	13	$T_j = 135$°C	
							$R_{th\,j-a} = 0.55$°C/mW	
BFW10	$I_{DSS} < 20$ mA	15	0	$-V_{GS} < 7.5$ V	0.4	15	$I_D = 20$ mA	length < 5.3
n-channel	$F < 2.5$ dB	15	0	$-V_{(P)GS} < 8$ V	0.5 nA	15	$\pm V_{DS} = 30$ V	width < 4.8
broad-band	$\lvert y_{fs}\rvert > 3{,}5$ mA/V	15	0				$P_{tot} = 300$ mW	leads > 12.7
ampl.	$-C_{rs} < 0{,}8$ pF	15	0				$T_j = 200$°C	
							$R_{th\,j-a} = 0.59$°C/mW	
BFW11	$I_{DSS} < 10$ mA	15	0	$-V_{GS} < 4$ V	0.05	15	$I_D = 20$ mA	length < 5.3
n-channel	$F < 2.5$ dB	15	0	$-V_{(P)GS} < 6$ V	0.5 nA	15	$\pm V_{DS} = 30$ V	width < 4.8
broad-band	$\lvert y_{fs}\rvert > 3$ mA/V	15	0				$P_{tot} = 300$ mW	leads > 12.7
ampl.	$-C_{rs} < 0{,}8$ pF	15	0				$T_j = 200$°C	
							$R_{th\,j-a} = 0.59$°C/mW	
BFW12	$-I_{GSS} < 0.1$ nA	0	−10	$-V_{GS} < 2$ V	50 μA	15	$I_D = 10$ mA	length < 5.3
n-channel	$I_{DSS} < 5$ mA	15	0	$-V_{(P)GS} < 2.5$ V	0.5 nA	15	$\pm V_{DS} = 30$ V	width < 4.8
low current/	$\lvert y_{fs}\rvert > 2.0$ mA/V	15	0	$\lvert y_{fs}\rvert > 1.5$ mA/V	0.5	15	$P_{tot} = 150$ mW	leads > 12.7
low voltage	$-C_{rs} < 0.8$ pF	15	0				$T_j = 200$°C	
applications							$R_{th\,j-a} = 0.59$°C/mW	

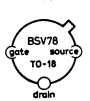


BFW13	I_{DSS}	< 1.5 mA	15	0	$-V_{GS}$	< 1 V	50 μA	15	I_D = 10 mA	length < 5.3
n-channel	$-I_{GSS}$	< 0.1 nA	0	−10	$-V_{(P)GS}$	< 1.2 V	0.5 nA	15	$\pm V_{DS}$ = 30 V	width < 4.8
low current/	$\lvert y_{fs}\rvert$	> 1.0 mA/V	15	0	$\lvert y_{fs}\rvert$	> 0.5 mA/V	0.2	15	P_{tot} = 150 mW	leads > 12.7
low voltage	$-C_{rs}$	< 0.8 pF	15	0					T_j = 200°C	
applications									$R_{th\,j-a}$ = 0.59°C/mW	

BFW61	I_{DSS}	< 20 mA	15	0	$-V_{GS}$	< 7.5 V	0.2	15	I_D = 20 mA	length < 5.3
n-channel	$\lvert y_{fs}\rvert$	> 2 mA/V	15	0	$-V_{(P)GS}$	< 8 V	1 nA	15	$\pm V_{DS}$ = 25 V	width < 4.8
									P_{tot} = 300 mW	leads > 12.7
									T_j = 200°C	
									$R_{th\,j-a}$ = 0.59°C/mW	



BSV78	I_{DSS}	> 50 mA	15	0	$-V_{GS}$	< 10 V	1.5 μA	15	I_G = 50 mA	length < 5.3
n-channel	$-I_{GSS}$	< 0.25 nA	0	−20	$-V_{(P)GS}$	< 11 V	1 nA	15	V_{DS} = 40 V	width < 4.8
switch	$-C_{rs}$	< 5 pF	0	−10			I_D	V_{GS}	P_{tot} = 350 mW	leads > 12.7
					$r_{ds\,on}$	< 25 Ω	0	0	T_j = 175°C	
									$R_{th\,j-a}$ = 0.43°C/mW	

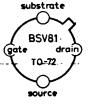


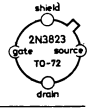
BSV79	I_{DSS}	> 20 mA	15	0	$-V_{GS}$	< 6 V	1.5 μA	15	I_G = 50 mA	**length < 5.3**
n-channel	$-I_{GSS}$	< 0.25 nA	0	−20	$-V_{(P)GS}$	< 7 V	1 nA	15	V_{DS} = 40 V	**width < 4.8**
switch	$-C_{rs}$	< 5 pF	0	−10			I_D	V_{GS}	P_{tot} = 350 mW	**leads > 12.7**
					$r_{ds\,on}$	< 40 Ω	0	0	T_j = 175°C	
									$R_{th\,j-a}$ = 0.43°C/mW	

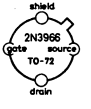
BSV80	I_{DSS}	> 10 mA	15	0	$-V_{GS}$	< 4 V	1.5 μA	15	I_G = 50 mA	length < 5.3
n-channel	$-I_{GSS}$	< 0.25 nA	0	−20	$-V_{(P)GS}$	< 5 V	1 nA	15	V_{DS} = 40 V	width < 4.8
switch	$-C_{rs}$	< 5 pF	0	−10			I_D	V_{GS}	P_{tot} = 350 mW	leads > 12.7
					$r_{ds\,on}$	< 60 Ω	0	0	T_j = 175°C	
									$R_{th\,j-a}$ = 0.43°C/mW	

FIELD EFFECT TRANSISTORS

Type and applications	*Characteristics at:*	V_{DS} (V)	V_{GS} (V)	*Characteristics at:*	I_D (mA)	V_{DS} (V)	*Ratings*	*Outlines (mm)*
BSV 81	I_{DSX} < 1 nA	10	−5				I_{DM} = 50 mA	length < 5.3
n-channel	$-I_{GSS}$ < 10 pA	0	−10				I_{SM} = 50 mA	width < 4.8
switch	I_{GSS} < 10 pA	0	10				V_{DB} = 30 V	leads > 12.7
chopper	$r_{ds\,on}$ < 100 Ω	0	0				V_{SB} = 30 V	
	$r_{DS\,off}$ > 10 GΩ	10	−5				$\pm V_{GB}$ = 10 V	
	C_{rs} < 0.5 pF	0	−5				$\pm V_{G-N}$ = 15 V	
	C_{rd} < 1.2 pF	0	−5				P_{tot} = 200 mW	
							T_j = 125°C	
							$R_{th\,j-a}$ = 0.5°C/mW	
2N3823	I_{DSS} < 20 mA	15	0	$-V_{GS}$ < 7.5 V	0.4	15	I_G = 10 mA	length < 5.3
n-channel	$-I_{GSS}$ < 0.5 nA	0	−20	$-V_{(P)GS}$ < 8 V	0.5 nA	15	V_{DS} = 30 V	width < 4.8
i.f.; r.f.	$\lvert y_{fs}\rvert$ < 6.5 mΩ^{-1}	15	0				P_{tot} = 300 mW	leads > 12.7
ampl.	$-C_{rs}$ < 2 pF	15	0				T_j = 200°C	
2N3966	I_{DSS} > 2 mA	20	0	$-V_{(P)GS}$ < 6 V	10 nA	10	I_G = 10 mA	length < 5.3
n-channel	$-I_{GSS}$ < 1 nA	0	−20		I_D	V_{GS}	$\pm V_{DS}$ = 30 V	width < 4.8
switch	$-C_{rs}$ < 1.5 pF	0	7	$r_{ds\,on}$ < 220 Ω	0	0	V_{DGO} = 30 V	leads > 12.7
multiplexing				t_d < 20 ns			$-V_{GSO}$ = 30 V	
systems				t_r < 100 ns			P_{tot} = 300 mW	
				t_{off} < 100 ns			T_j = 200°C	
							$R_{th\,j-a}$ = 0.59°C/mW	







2N4091	I_{DSS} > 30 mA	20	0	$V_{DS\,on}$ < 0.2 V	6.6	0	I_G	= 10 mA	length < 5.3	
n-channel	I_D < 0.2 nA	20	−12	$-V_{GS}$ < 10 V	1	20	$\pm V_{DS}$	= 40 V	width < 4.8	
low power	$-C_{rs}$ < 5 pF	0	20		I_D	V_{GS}	V_{DGO}	= 40 V	leads > 12.7	
switch				$r_{ds\,on}$ = 30 Ω	0	0	$-V_{GSO}$	= 40 V		
				t_d < 15 ns			P_{tot}	= 1.8 W		
				t_r < 10 ns			T_j	= 200°C		
				t_{off} < 40 ns			$R_{th\,j-c}$	= 0.1°C/mW		

2N4092	I_{DSS} > 15 mA	20	0	$V_{DS\,on}$ < 0.2 V	4	0	I_G	= 10 mA	length < 5.3	
n-channel	I_D < 0.2 nA	20	−8	$-V_{GS}$ < 7 V	1	20	$\pm V_{DS}$	= 40 V	width < 4.8	
low power	$-C_{rs}$ < 5 pF	0	20		I_D	V_{GS}	V_{DGO}	= 40 V	leads > 12.7	
switch				$r_{ds\,on}$ = 50 Ω	0	0	$-V_{GSO}$	= 40 V		
				t_d < 15 ns			P_{tot}	= 1.8 W		
				t_r < 20 ns			T_j	= 200°C		
				t_{off} < 60 ns			$R_{th\,j-c}$	= 0.1°C/mW		

2N4093	I_{DSS} > 8 mA	20	0	$V_{DS\,on}$ < 0.2 V	2.5	0	I_G	= 10 mA	length < 5.3	
n-channel	I_D < 0.2 nA	20	−6	$-V_{GS}$ < 5 V	1	20	$\pm V_{DS}$	= 40 V	width < 4.8	
low power	$-C_{rs}$ < 5 pF	0	20		I_D	V_{GS}	V_{DGO}	= 40 V	leads > 12.7	
switch				$r_{ds\,on}$ < 80 Ω	0	0	$-V_{GSO}$	= 40 V		
				t_d < 20 ns			P_{tot}	= 1.8 W		
				t_r < 40 ns			T_j	= 200°C		
				t_{off} < 80 ns			$R_{th\,j-c}$	= 0.1°C/mW		

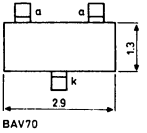
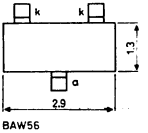
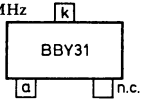
2N4391	I_{DSS} < 150 mA	20	0	$V_{DS\,on}$ < 0.4 V	12	0	I_G	= 50 mA	length < 5.3	
n-channel	I_{DSX} < 0.1 nA	20	−12	$-V_{(P)GS}$ < 10 V	1 nA	20	$\pm V_{DS}$	= 40 V	width < 4.8	
low power	$-C_{rs}$ < 3.5 pF	0	−12		I_D	V_{GS}	V_{DGO}	= 40 V	leads > 12.7	
chopper					0	0	$-V_{GSO}$	= 40 V		
switch				$r_{ds\,on}$ < 30 Ω			P_{tot}	= 1.8 W		
				t_r < 5 ns			T_j	= 200°C		
				t_f < 15 ns			$R_{th\,j-c}$	= 0.1°C/mW		
				t_{off} < 20 ns						

FIELD EFFECT TRANSISTORS

Type and applications	*Characteristics at:*	V_{DS} (V)	V_{GS} (V)	*Characteristics at:*	I_D (mA)	V_{DS} (V)	*Ratings*	*Outlines (mm)*
2N4392	$I_{DSS} < 75$ mA	20	0	$V_{DS\,on} < 0.4$ V	6	0	$I_G = 50$ mA	length < 5.3
n-channel	$I_{DSX} < 0.1$ nA	20	−7	$-V_{(P)GS} < 5$ V	1 nA	20	$\pm V_{DS} = 40$ V	width < 4.8
low power	$-C_{rs} < 3.5$ pF	0	−7		I_D	V_{GS}	$V_{DGO} = 40$ V	leads > 12.7
chopper				$r_{ds\,on} < 60\ \Omega$	0	0	$-V_{GSO} = 40$ V	
switch				$t_r < 5$ ns			$P_{tot} = 1.8$ W	
				$t_{on} < 15$ ns			$T_j = 200°C$	
				$t_f < 20$ ns			$R_{th\,j-c} = 0.1°C/mW$	
				$t_{off} < 35$ ns				
2N4393	$I_{DSS} < 30$ mA	20	0	$V_{DS\,on} < 0.4$ V	3	0	$I_G = 50$ mA	length < 5.3
n-channel	$I_{DSX} < 0.1$ nA	20	5	$-V_{(P)GS} < 3$ V	1 nA	20	$\pm V_{DS} = 40$ V	width < 4.8
low power	$-C_{rs} < 3.5$ pF	0	−5		I_D	V_{GS}	$V_{DGO} = 40$ V	leads > 12.7
switch				$r_{ds\,on} < 100\ \Omega$	0	0	$-V_{GSO} = 40$ V	
				$t_r < 5$ ns			$P_{tot} = 1.8$ W	
				$t_{on} < 15$ ns			$T_j = 200°C$	
				$t_f < 30$ ns			$R_{th\,j-c} = 0.1°C/mW$	
				$t_{off} < 50$ ns				
2N4856	$I_{DSS} > 50$ mA	15	0	$-V_{(P)GS} < 10$ V	0.5 nA	15	$I_G = 50$ mA	length < 5.3
n-channel	$I_{DSX} < 0.25$ nA	15	−10		I_D	V_{GS}	$\pm V_{DS} = 40$ V	width < 4.8
low power	$-I_{GSS} < 0.25$ nA	0	−20	$V_{DS\,on} < 0.75$ V	20	0	$V_{DGO} = 40$ V	leads > 12.7
chopper	$-C_{rs} < 8$ pF	0	−10	$r_{ds\,on} < 25\ \Omega$	0	0	$-V_{GSO} = 40$ V	
switch				$t_d < 6$ ns			$P_{tot} = 360$ mW	
				$t_r < 3$ ns			$T_j = 200°C$	
				$t_{off} < 25$ ns			$R_{th\,j-a} = 0.49°C/mW$	

2N4857	Equivalent to 2N4856 except for:			$-V_{(P)GS}$ < 6 V	0.5 nA	15
	I_{DSS} > 20 mA	15	0		I_D	V_{GS}
				$V_{DS\,on}$ < 0.50 V	10	0
				$r_{ds\,on}$ < 40 Ω	0	0
				t_r < 4 ns		
				t_{off} < 50 ns		
2N4858	Equivalent to 2N4856 except for:			$-V_{(P)GS}$ < 4 V	0.5 nA	15
	I_{DSS} > 8 mA	15	0		I_D	V_{GS}
				$V_{DS\,on}$ < 0.50 V	5	0
				$r_{ds\,on}$ < 60 Ω	0	0
				t_d < 10 ns		
				t_r < 10 ns		
				t_{off} < 100 ns		
2N4859	Equivalent to 2N4856 except for:					
	$-I_{GSS}$ < 0.25 nA	0	−15			
2N4860	Equivalent to 2N4856 except for:			$-V_{(P)GS}$ < 6 V	0.5 nA	15
	I_{DSS} < 100 mA	15	0		I_D	V_{GS}
	$-I_{GSS}$ < 0.25 nA	0	−15	$V_{DS\,on}$ < 0.50 V	10	0
				$r_{ds\,on}$ < 40 Ω	0	0
				t_r < 4 ns		
				t_{off} < 50 ns		
2N4861	Equivalent to 2N4856 except for:			$-V_{(P)GS}$ < 4 V	0.5 nA	15 V
	I_{DSS} < 80 mA	15	0		I_D	V_{GS}
	$-I_{GSS}$ < 0.25 nA	0	−15	$V_{DS\,on}$ < 0.50 V	5	0
				$r_{ds\,on}$ < 60 Ω	0	0
				t_d < 10 ns		
				t_r < 10 ns		
				t_{off} < 100 ns		

MICROMINIATURE DEVICES FOR THICK- AND THIN-FILM CIRCUITS

Type and applications	*Ratings* (*mA*) (*V*) (°C)	$R_{th\,j-a}$ (°C/mW)	V_F at I_F (*V*) (*mA*)	I_R at V_R (*μA*) (*V*)	*Char.*	*Outlines* (*mm*)
BAV70 thick- and thin-film high speed switch planar epitaxial	$I_{F(AV)}$ = 50 I_{FRM} = 100 V_R = 25 V_{RRM} = 50 T_j = 125 T_{stg} = +125	1,4	T_j = 25°C <0,715 1 <0,855 10 <1,100 50 <1,300 100	T_j = 125°C <15 10 <20 25	C_d < 1,5 pF Q_s < 45 pC	 BAV70
BAW56 thick- and thin-film high speed switch planar epitaxial	I_{FAV} = 50 I_{FRM} = 100 V_R = 25 V_{RRM} = 50 T_j = 125 T_{stg} = +125	1.4	T_j = 25°C <0.715 1 <0.855 10 <1.1 50 <1.3 100	T_j = 125°C <8 10 <10 25	C_d < 2 pF Q_s < 45 pC	 BAW56
BBY31 variable capacitance silicon planar electronic tunning	I_F = 20 V_R = 28 V_{RM} = 30 T_j = 60 T_{stg} = +100	0,9		T_j = 25°C <0,1 28 T_j = 60°C <0,5 28	f = 1 MHz C_d = 17,5 pF; V_R = 1 V C_d = 11,5 pF; V_R = 3 V C_d = 1,8 to 2,8 pF at V_R = 25 V r_D < 1,2 Ω at C_d = 9 pF; f = 470 MHz	length < 2,9 width < 1,3 height < 0,85 leads = 0,5 

Type and applications	*Characteristics at:*	I_C *(mA)*	V_{CE} *(V)*	I_E *(mA)*	V_{CB} *(V)*	*Characteristics at:*	I_C *(mA)*	I_B *(mA)*	*Ratings*	*Outlines (mm)*
BCW29	$-V_{BE} > 600$ mV	-2	-5			$-V_{CE\,sat} = 180$ mV	-50	-2.5	$-I_{CM} = 200$ mA	length < 2.9
p-n-p	$-V_{BE} < 750$ mV	-2	-5			$-V_{BE\,sat} = 810$ mV	-50	-2.5	$-V_{CEO} = 20$ V	width < 1.3
general	$h_{FE} > 120$	-2	-5						$P_{tot} = 150$ mW	height < 0.85
	$h_{FE} < 260$	-2	-5						$T_j = 125$°C	leads $= 0.5$
	$f_T = 150$ MHz	-10	-5						$R_{th\,j-a} = 0.9$°C/mW	
	$F < 10$ dB	-0.2	-5							
	$-I_{CBO} < 100$ nA			0	-20					
	$C_c = 7$ pF			0	-10					
BCW30	Equivalent to BCW29 except for:									
	$h_{FE} > 215$	-2	-5							
	$h_{FE} < 500$	-2	-5							
BCW31	$V_{BE} > 550$ mV	2	5			$V_{CE\,sat} = 230$ mV	50	2.5	$I_{CM} = 200$ mA	length < 2.9
n-p-n	$V_{BE} < 700$ mV	2	5			$V_{BE\,sat} = 870$ mV	50	2.5	$V_{CEO} = 20$ V	width < 1.3
general	$h_{FE} > 110$	2	5						$P_{tot} = 150$ mW	height < 0.85
	$h_{FE} < 220$	2	5						$T_j = 125$°C	leads $= 0.5$
	$f_T = 300$ MHz	10	5						$R_{th\,j-a} = 0.9$°C/mW	
	$F < 10$ dB	0.2	5							
	$I_{CBO} < 100$ nA			0	20					
	$C_c = 4$ pF			0	10					
BCW32	Equivalent to BCW31 except for:									
	$h_{FE} > 200$	2	5							
	$h_{FE} < 450$	2	5							
BCW33	Equivalent to BCW31 except for:									
	$h_{FE} > 420$	2	5							
	$h_{FE} < 800$	2	5							

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	I_E (*mA*)	V_{CB} (*V*)	*Characteristics at:*	I_C (*mA*)	I_B (*mA*)	*Ratings*	*Outlines (mm)*
BCW 69	$-V_{BE} > 600$ mV	−2	−5			$V_{CE\,sat} < 300$ mV	−10	−0.5	$-I_{CM} = 200$ mA	length < 2.9
p-n-p	$-V_{BE} < 750$ mV	−2	−5			$V_{CE\,sat} = 180$ mV	−50	−2.5	$-V_{CEO} = 45$ V	width < 1.3
general	$h_{FE} = 90$	−0.01	−5			$V_{BE\,sat} = 720$ mV	−10	−0.5	$P_{tot} = 150$ mW	height < 0.85
	$h_{FE} > 120$	−2	−5			$V_{BE\,sat} = 810$ mV	−50	−2.5	$T_j = 125°C$	leads = 0.5
	$h_{FE} < 260$	−2	−5						$R_{th\,j-a} = 0.9°C/mW$	
	$f_T = 150$ MHz	−10	−5							
	$F < 10$ dB	−0.2	−5							
	$-I_{CBO} < 100$ nA			0	−20					
	$C_c < 7$ pF			0	−10					
BCW70	Equivalent to BCW69 except for:									
	$h_{FE} > 150$	−0.01	−5							
	$h_{FE} > 215$	−2	−5							
	$h_{FE} < 500$	−2	−5							
BCW71	$V_{BE} > 550$ mV	2	5			$V_{CE\,sat} < 250$ mV	10	0.5	$I_{CM} = 200$ mA	length < 2.9
n-p-n	$V_{BE} < 700$ mV	2	5			$V_{CE\,sat} = 230$ mV	50	2.5	$V_{CEO} = 45$ V	width < 1.3
general	$h_{FE} = 90$	0.01	5			$V_{BE\,sat} = 750$ mV	10	0.5	$P_{tot} = 150$ mW	height < 0.85
	$h_{FE} > 110$	2	5			$V_{BE\,sat} = 870$ mV	50	2.5	$T_j = 125°C$	leads = 0.5
	$h_{FE} < 220$	2	5						$R_{th\,j-a} = 0.9°C/mW$	
	$f_T = 300$ MHz	10	5							
	$F < 10$ dB	0.2	5							
	$I_{CBO} < 100$ nA			0	20					
	$C_c < 4$ pF			0	10					
BCW72	Equivalent to BCW71 except for:									
	$h_{FE} = 150$	0.01	5							
	$h_{FE} > 200$	2	5							
	$h_{FE} < 450$	2	5							

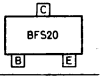
Type and applications	*Characteristics at:*	V_{DS} (V)	V_{GS} (V)	*Characteristics at:*	I_D (mA)	V_{DS} (V)	*Ratings*	*Outlines (mm)*
BFR30	$-I_{GSS} < 0{,}2$ nA	0	−10	$-V_{GS} < 3{,}0$ V	1	10	$I_D = 10$ mA	length < 2,9
n-channel	$I_{DSS} < 10$ mA	10	0	$-V_{(P)GS} < 5$ V	0,5 nA	10	$\pm V_{DS} = 25$ V	width < 1,3
general				$\lvert y_{fs}\rvert > 1$ mA/V	1	10	$P_{tot} = 150$ mW	height < 0,85
purpose				$-C_{rs} \pm 1{,}5$ pF	1	10	$T_j = 125$°C	leads = 0,5
amplifier				$-C_{rs} < 1{,}5$ pF	0,2	10	$R_{th\,j-a} = 0{,}9$°C/mW	

BFR31	$-I_{GSS} < 0{,}2$ nA	0	−10	$-V_{GS} < 1{,}3$ V	1	10	$I_D = 10$ mA	length < 2,9
n-channel	$-I_{DSS} < 5$ mA	10	0	$-V_{(P)GS} < 2{,}5$ V	0,5 nA	10	$\pm V_{DS} = 25$ V	width < 1,3
general				$\lvert y_{fs}\rvert > 1{,}5$ mA/V	1	10	$P_{tot} = 150$ mW	height < 0,85
purpose				$-C_{rs} < 1{,}5$ pF	1	10	$T_j = 125$°C	leads = 0,5
amplifier				$-C_{rs} < 1{,}5$ pF	0,2	10	$R_{th\,j-a} = 0{,}9$°C/mW	

Type and applications	*Characteristics at:*	I_C (mA)	V_{CE} (V)	*Characteristics at*	I_E	V_{CB} (V)	*Ratings*	*Outlines (mm)*
BFR53	$h_{FE} > 25$	25	5	$I_{CBO} < 50$ mA	0	10	$I_{CM} = 100$ mA	length < 2,9
n-p-n	$h_{FE} > 25$	50	5	$C_c = 0{,}9$ pF	0	5	$V_{CEO} < 10$ V	width < 1,3
wideband	$f_T = 2{,}0$ GHz	2	5				$P_{tot} = 180$ mW	height < 0,85
vertical	$F < 5$ dB	2	5				$T_j = 150$°C	leads = 0,5
amplifiers	$G_{tr(um)} = 22$ dB	30	5				$R_{th\,j-a} = 0{,}5$°C/mW	
	$d_{im} = -60$ dB	30	5					

MICROMINIATURE DEVICES FOR THICK- AND THIN-FILM CIRCUITS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	*Characteristics at*	I_E	V_{CB} (*V*)	*Ratings*	*Outlines (mm)*
BFR92	h_{FE} = 50	14	10	I_{CBO} < 50 nA	0	10	I_C = 25 mA	length < 2,9
n-p-n	f_T = 5 GHz	14	10				V_{CEO} = 15 V	width < 1,3
u.h.f. and	F = 2,4 dB	2	10	C_c = 0,75 pF	0	10	P_{tot} = 180 mW	height < 0,85
microwave	$G_{tr(um)}$ = 18 dB	14	10				T_j = 150°C	leads = 0,5
amplifiers	d_{im} = −60 dB	14	10				$R_{th\,j-a}$ = 0,5°C/mW	
BFR93	h_{FE} = 50	30	5	I_{CBO} < 50 nA	0	10	I_C = 35 mA	length < 2,9
n-p-n	f_T = 5 GHz	30	5	C_c = 0,7 pF	0	10	V_{CEO} = 12 V	width < 1,3
u.h.f. and	F = 1,9 dB	2	5				P_{tot} = 180 mW	height < 0,85
microwave	$G_{tr(um)}$ = 16,5 dB	30	5				T_j = 150°C	leads = 0,5
amplifiers	d_{im} = −60 dB	30	5				$R_{th\,j-a}$ = 0,5°C/W	

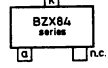
Type and applications	Characteristics at:	I_C (mA)	V_{CE} (V)	I_E (mA)	V_{CB} (V)	Characteristics at:	I_C (mA)	I_B (mA)	Ratings	Outlines (mm)
BFS17	$h_{FE} > 20$	25	1						$I_{CM} = 50$ mA	length < 2.9
n-p-n	$f_T = 1$ GHz	2	5						$V_{CEO} = 15$	width < 1.3
v.h.f.	$-C_{re} = 0.65$ pF	2	5						$P_{tot} = 150$ mW	height < 0.85
u.h.f.	$F = 4.5$ dB	2	5						$T_j = 125$°C	leads = 0.5
	$d_{im} = -45$ dB	10	6						$R_{th\,j-a} = 0.9$°C/mW	
	$I_{CBO} < 10$ nA			0	10					
	$C_c < 1.5$ pF			0	10					
BFS18	$V_{BE} > 0.65$ V	1	10						$I_{CM} = 30$ mA	length < 2.9
n-p-n	$V_{BE} < 0.74$ V	1	10						$V_{CEO} = 20$ V	width < 1.3
h.f.	$h_{FE} > 35$	1	10						$P_{tot} = 150$ mW	height < 0.85
	$h_{FE} < 125$	1	10						$T_j = 125$°C	leads = 0.5
	$f_T = 200$ MHz	1	10						$R_{th\,j-a} = 0.9$°C/mW	
	$F = 4$ dB	1	10							
	$I_{CBO} < 100$ nA			0	20					
	$C_c = 1$ pF			0	10					
BFS19	Equivalent to BFS18 except for:									
	$h_{FE} > 65$	1	10							
	$h_{FE} < 225$	1	10							
	$f_T = 260$ MHz	1	10							
BFS20	$V_{BE} = 740$ mV	7	10						$I_{CM} = 25$ mA	length < 2.9
n-p-n	$h_{FE} = 85$	7	10						$V_{CEO} = 20$ V	width < 1.3
i.f.	$f_T = 450$ MHz	5	10						$P_{tot} = 150$ mW	height < 0.85
v.h.f.	$I_{CBO} < 100$ nA			0	20				$T_j = 125$°C	leads = 0.5
	$C_c = 0.8$ pF			0	10				$R_{th\,j-a} = 0.9$°C/mW	

MICROMINIATURE DEVICES FOR THICK- AND THIN-FILM CIRCUITS

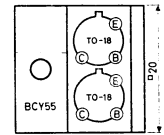
Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	I_E (*mA*)	V_{CB} (*V*)	*Characteristics at:*	I_C (*mA*)	I_B (*mA*)	*Ratings*	*Outlines (mm)*
BSV52	$h_{FE} > 25$	1	1			$V_{CE\,sat} < 400$ mV	50	5	$I_{CM} = 200$ mA	length < 2.9
n-p-n	$h_{FE} > 25$	50	1			$V_{BE\,sat} < 1200$ mV	50	5	$V_{CEO} = 12$ V	width < 1.3
very high	$f_T = 500$ MHz	10	10			$t_s < 13$ ns			$P_{tot} = 150$ mV	height < 0.85
switching	$I_{CBO} < 100$ nA			0	10	$t_{on} < 12$ ns			$T_j = 125°C$	leads = 0.5
						$t_{off} < 18$ ns			$R_{th\,j-a} = 0.9°C/mW$	

BZX84series	**C4V7**	**C5V1**	**C5V6**	**C6V2**	**C6V8**	**C7V5**	**C8V2**	**C9V1**	**C10**	**C11**	**C12**
at I_Z (mA)	5	5	5	5	5	5	5	5	5	5	5
V_Z (V)	4,7	5,1	5,6	6,2	6,8	7,5	8,2	9,1	10	11	12
S_Z (mV/°C)	−1,4	−0,8	+1,2	+2,3	+3	+4	+5	+6	+7	+8	+9
r_z (Ω)	80	70	40	20	20	20	20	20	25	30	30

length < 2,9
width < 1,3
height < 0,85
leads = 0,5

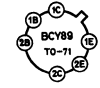


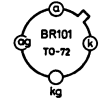
MISCELLANEOUS TRANSISTORS

Type and applications	*Characteristics at:*	I_C *(mA)*	V_{CE} *(V)*	*Characteristics at:*	I_E *(mA)*	V_{CB} *(V)*	*Ratings*	*Outlines (mm)*
BCY55	h_{FE} > 100	0.01	5	I_{CBO} < 10 nA	0	45	I_{CM} = 60 mA	
n-p-n	h_{FE} > 200	10	5	C_c < 8 pF	0	5	V_{CEO} = 45 V	
dual-tr.	f_T = 80 MHz	0.5	5				P_{tot} = 300 mW	
	f_{hfe} > 0.1 MHz	0.5	5				T_j = 125°C	
	F > 0.1 dB	0.01	5				$R_{th\,j-a}$ = 0.33°C/mW	
	h_{fe} > 150	1	5					
Characteristics of	ΔV_{BE} < 3 mV			$\Delta V/\Delta T$ < 6 μV/°C				
the matched tr.	I_{1C}/I_{2C} > 0.8			$\Delta T/\Delta T$ < 2 nA/°C				
BCY87	F < 3 dB	0.05	5	I_{CBO} < 5 nA	0	20	I_C = 30 mA	length > 5.3
n-p-n				h_{FE} > 100	−0.05	10	V_{CEO} = 40 V	width > 4.8
dual-tr.				h_{FE} < 450	−0.05	10	P_{tot} = 150 mW	leads < 12.7
				C_c < 3.5 pF	0	10	T_j = 175°C	
				f_T > 50 MHz	−0.5	10	$R_{th\,j-a}$ = 1°C/mW	
Characteristics of	ΔV_{BE} < 3 mV			$\Delta V/\Delta T$ < 3 μV/°C				
the matched tr.	I_{1C}/I_{2C} > 0.9			$\Delta I/\Delta T$ < 0.5 nA/°C				
BCY88	F < 4 dB	0.05	5	I_{CBO} < 20 nA	0	20	I_C = 30 mA	length > 5.3
n-p-n				h_{FE} > 120	−0.5	10	V_{CEO} = 40 V	width > 4.8
dual-tr.				h_{FE} < 600	−0.5	10	P_{tot} = 150 mW	leads < 12.7
				C_c < 3.5 pF	0	10	T_j = 175°C	
				f_T > 50 MHz	−0.5	10	$R_{th\,j-a}$ = 1°C/mW	
Characteristics of	ΔV_{BE} < 6 mV			$\Delta V/\Delta T$ < 6 μV/°C				
the matched tr.	I_{1C}/I_{2C} > 0.8			$\Delta I/\Delta T$ < 2 nA/°C				

MISCELLANEOUS TRANSISTORS

Type and applications	*Characteristics at:*	I_C *(mA)*	V_{CE} *(V)*	*Characteristics at:*	I_E *(mA)*	V_{CB} *(V)*	*Ratings*	*Outlines (mm)*
BCY89	$F < 4$ dB	0.05	5	$I_{CBO} < 10$ nA	0	20	$I_C = 30$ mA	length > 5.3
n-p-n				$h_{FE} > 100$	−10	10	$V_{CEO} = 40$ V	width > 4.8
dual-tr.				$h_{FE} < 600$	−10	10	$P_{tot} = 150$ mW	leads < 12.7
				$C_c < 3.5$ pF	0	10	$T_j = 175$°C	
				$f_T > 50$ MHz	−0.5	10	$R_{th\,j-a}$ /1°C/mW	
Characteristics of the matched tr.	$\Delta V_{BE} < 10$ mV $I_{1C}/I_{2C} > 0.7$			$\Delta V/\Delta T < 10$ μV/°C $\Delta I/\Delta T < 10$ nA/°C				
BR101	n-p-n transistor	10	2	$C_c < 5$ pF	0	20	$I_{CM} = 175$ mA	length < 5,3
p-n-p-n	$h_{FE} > 50$	10	2				$V_{CER} = 50$ V	width < 4,8
Time base circuits	$f_T = 300$ MHz							leads > 12,7
Television applications	p-n-p transistor							
				$h_{FE} > 0{,}25$	1	0	$I_E = 175$ mA	
				$h_{FE} < 2{,}5$	1	0	$I_{ERM} = 2{,}5$ A	
							$-V_{CEO} = 50$ V	
	Combined device: $R_{KG-K} = 10$ kΩ							
	$V_{AK} < 1{,}4$ V at $I_A = 50$ mA; $I_{AG} = 0$						$P_{tot} = 275$ mW	
	$V_{AK} < 1{,}2$ V at $I_A = 1$ mA; $I_{AG} = 10$ mA						$T_j = 150$°C	
	$I_H > 0{,}1$ and $< 1{,}0$ at $I_{AG} = 10$ mA; $-V_{BB} = 2$ V						$R_{th\,j-a} = 0{,}45$°C/mW	





BRY39(SCS)
p-n-p-n driver numerical indicator tubes

n-p-n transistor:
$h_{FE} > 50$ 10 2
$f_T = 300$ MHz 10 2

p-n-p transistor:
$h_{FE} > 0{,}25$ 1 0
$h_{FE} < 2{,}5$ 1 0

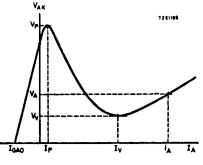
$I_{CM} = 175$ mA
$V_{CER} = 70$ V
$I_E = 175$ mA
$I_{ERM} = 2{,}5$ V
$-V_{CEO} = 70$ V

Combined device: $R_{KG-K} = 10$ kΩ
$V_{AK} < 1{,}4$; $I_A = 50$ mA; $I_{AG} = 0$
$V_{AK} < 1{,}2$ V; $I_A = 1$ mA; $I_{AG} = 10$ mA
$I_H > 0{,}1$ and $< 1{,}0$ at $I_{AG} = 10$ mA; $-V_{BB} = 2$ V
$t_{on} < 1{,}5$ μs at $-V_{KG-K} = 0{,}5$ V to $+V_{KG-K} = 4{,}5$ V
$t_g < 8$ μs at $R_{KG-K} = 10$ kΩ

$P_{tot} = 275$ mW
$T_j = 150$°C
$R_{th\,j-a} = 0{,}45$°C/mW

BRY39(PUT)
p-n-p-n motor control oscillators relays timers pulse shapers trigger devices

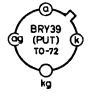
$I_P < 5$ μA at $V_S = 10$ V; $R_G = 10$ kΩ
$I_P < 1$ μA at $V_S = 10$ V; $R_G = 1$ MΩ
$I_V > 50$ μA at $V_S = 10$ V; $R_G = 10$ kΩ
$I_V < 50$ μA at $V_S = 10$ V; $R_G = 1$ MΩ
$I_{GAO} < 10$ nA at $I_K = 0$; $V_{GA} = 70$ V
$I_{GKS} < 100$ nA at $V_{AK} = 0$; $V_{GK} = 70$ V
$V_A < 1.4$ V at $I_A = 100$ mA
$V_{OM} > 6$ V at $V_{AA} = 20$ V; $C = 0.2$ μF
$t_r < 80$ ns at $V_{AA} = 20$ V; $C = 10$ nF

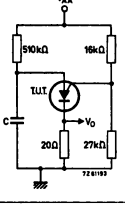


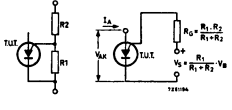
$I_A = 175$ mA
$I_{ARM} = 2.5$ A
$I_{ASM} = 3$ A
$dI_A/dt = 20$ A/μs
$V_{GA} = 70$ V
$T_j = 150$°C

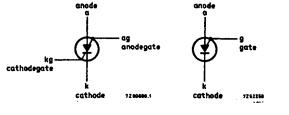
$R_{th\,j-a} = 0.45$°C/mW

length < 5.3
width < 4.8
leads > 12.7









MISCELLANEOUS TRANSISTORS

Type and applications	*Characteristics at:*	I_C (*mA*)	V_{CE} (*V*)	*Characteristics at:*	I_E (*mA*)	V_{CB} (*V*)	*Ratings*	*Outlines (mm)*
40809	The package consists of: AC127; AC128; AC127/AC128							
package	For data of mentioned types see section: LOW FREQUENCY TRANSISTORS							
l.f.	Performance of a class-B complementary output stage:							
	$P_o \leqslant 1.2$ W	$I_{CM} = 470$ mA						
	$d_{tot} = 10\%$	$V_S = 9$ V						
	$V_{i(rms)} = 5.6$ mV							
40819	The package consists of: AC187; AC188; AC187/01; AC188/01							
package	For data of mentioned types see section: LOW FREQUENCY TRANSISTORS							
l.f.	AC187 (pre-amplifier)	500	1	h_{FE} 100 to 200				
	AC188 (driver)	500	1	h_{FE} 100 to 200				
	AC187/01 (output stage)	500	1	h_{FE} 200 to 500				
	AC188/01 (output stage)	500	1	h_{FE} 200 to 500				
	Performance of an audio amplifier							
	$P_o \leqslant 3$ W	$I_{CM} = 750$ mA		$P_o \leqslant 1$ W		$I_{CM} = 710$ mA		
	$d_{tot} = 10\%$	$V_S = 15$ V		$d_{tot} = 10\%$		$V_S = 6$ V		
	$V_{i(rms)} = 5.5$ mV			$V_{i(rms)} = 41$ mV				

40820 package h.f.

The package consists of: BF194B (mixer oscillator transistor)
BF195C (controlled first i.f. transistor)
BF195D (second i.f. transistor)

For data of mentioned types see section: HIGH FREQUENCY TRANSISTORS

except for: BF194B	1	10	I_B 5–9 μA
BF195C	1	10	I_B 9–14 μA
BF195D	1	10	I_B 14–26 μA

Performance of a h.f. section of 6 V m.w. radio receiver:

Signal to obtain:

$V_o = 10$ mV	$E = 25$ μV/m	$I_{tot} = 3$ mA
signal/noise = 26 dB	$E = 500$ μV/m	

MISCELLANEOUS TRANSISTORS

Type and applications	
40829 package h.f.	The package consists of: BF254B (mixer oscillator) BF255C (controlled first i.f. transistor) BF255D (second i.f. transistor) For data of mentioned types see section: HIGH FREQUENCY TRANSISTORS except for: BF254B $I_C = 1$ mA; $V_{CE} = 10$ V $I_B = 5$–9 μA BF255C $I_C = 1$ mA; $V_{CE} = 10$ V $I_B = 9$–14 μA BF225D $I_C = 1$ mA: $V_{CE} = 10$ V $I_B = 14$–26 μA Performance of a h.f. section of 6 V m.w. radio receiver: Signal to obtain: $V_o = 10$ mV $E = 25$ μV/m $I_{tot} = 3$ mA Signal/noise = 26 dB $E = 500$ μV/m
40835 package h.f.	The package consists of: BF494B (mixer oscillator) BF495C (controlled first i.f. transistor) BF495D (second i.f. transistor) For data of mentioned types see section: HIGH FREQUENCY TRANSISTORS except for: BF494B $I_C = 1$ mA; $V_{CE} = 10$ V $I_B = 5$– 9 μA BF495C $I_C = 1$ mA; $V_{CE} = 10$ V $I_B = 9$–14 μA BF495D $I_C = 1$ mA; $V_{CE} = 10$ V $I_B = 14$–26 μA

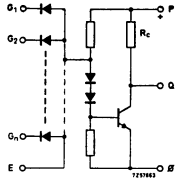
INTEGRATED CIRCUITS

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FC family (Diode-Transistor Logic)
Standard temperature range

Supply voltage	V_P	6.0 V ± 5%
Operating ambient temperature	T_{amb}	0 to 75°C

* collector resistor R_c omitted



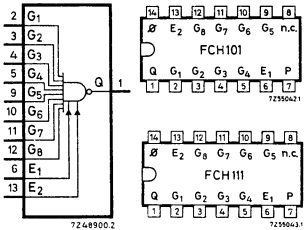
Basic gate circuit

CHARACTERISTICS at $T_{amb} = 25°C$ (each gate)

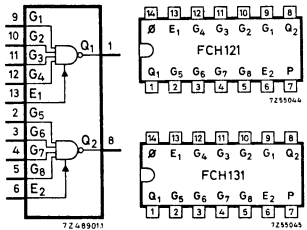
Type number	*Description (positive logic)*	t_{pd} *typ. (ns)*	N_a *min.*	M_L *typ. (V)*	P_{av} *typ. (mW)*	*Package*
FCH101*	Single 8-input NAND gate	30	8	1.2	7.0	DIL 14p
FCH111		30	8	1.2	11.0	DIL 14p
FCH121*	Dual 4-input NAND gate	30	8	1.2	7.0	DIL 14p
FCH131		30	8	1.2	11.0	DIL 14p
FCH141*	Triple 3-3-2 input NAND gate	30	8	1.2	7.0	DIL 14p
FCH161		30	8	1.2	11.0	DIL 14p
FCH151*	Triple 3-input NAND gate	30	8	1.2	7.0	DIL 14p
FCH171		30	8	1.2	11.0	DIL 14p
FCH181*	Quadruple 2-input NAND gate	30	8	1.2	7.0	DIL 14p
FCH191		30	8	1.2	11.0	DIL 14p
FCH201*	Sextuple inverter	30	8	1.2	7.0	DIL 14p
FCH211		30	8	1.2	11.0	DIL 14p

Logic diagrams and terminal connections

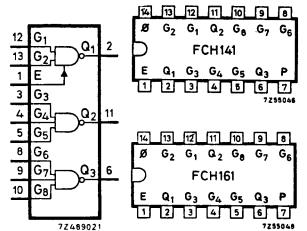
FCH101
FCH111



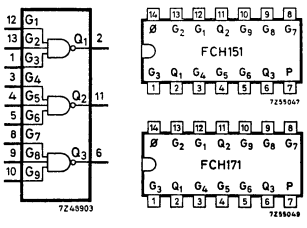
FCH121
FCH131



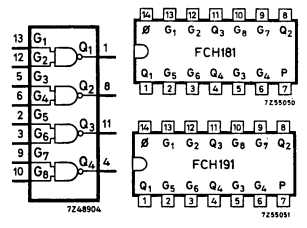
FCH141
FCH161



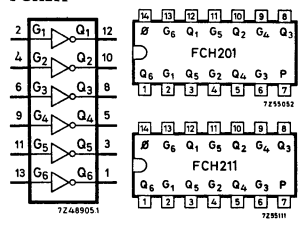
FCH151
FCH171



FCH181
FCH191



FCH201
FCH211



FC family (Diode-Transistor Logic)
Standard temperature range

Supply voltage	V_P	6.0 V ±5%
Operating ambient temperature	T_{amb}	0 to 75°C

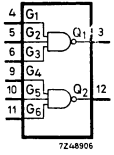
* Collector resistor R_c omitted

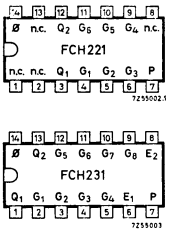
CHARACTERISTICS at $T_{amb}=25°C$

Type number	*Description (positive logic)*	t_{pd} *typ. (ns)*	N_a *min.*	M_L *typ. (V)*	P_{av} *typ. (mW)*	*Package*
FCH221	Dual 3-input line driver NAND gate	35	14	1.2	11 each gate	DIL 14p
FCH231	Dual 4-input line driver NAND gate	35	20	1.2	11 (each gate)	DIL 14p
FCH281	Single 5-bit comparator	150	7	1.2	50	DIL 14p
FCH291	Single 5-bit parity checker	150	7	1.2	110	DIL 14p
FCH301	Single 4-bit decoder	100	9	0.6	250	DIL 16p
FCH311*	Sextuple inverter	30	8	—	7	DIL 14p
FCH321		30	8	—	11	DIL 14p

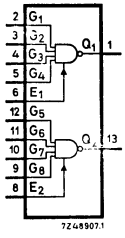
Logic diagrams and terminal connections

FCH221





FCH231



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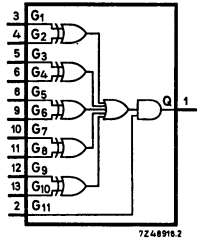

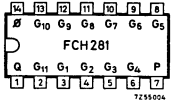

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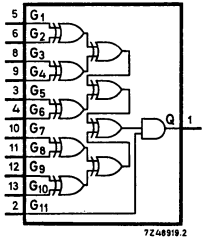
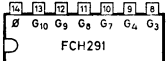
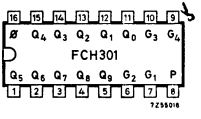
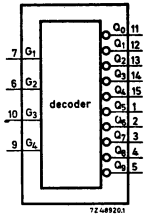


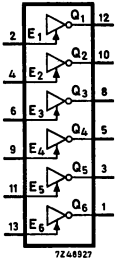


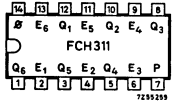
FCH301

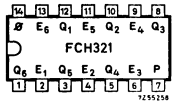




FCH311
FCH321







FC family (Diode-Transistor Logic)
Standard temperature range

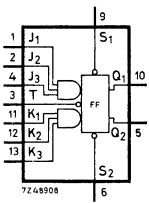
Supply voltage	V_P	6.0 V ±5%
Operating ambient temperature	T_{amb}	0 to 75°C

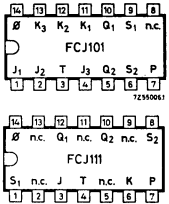
CHARACTERISTICS at $T_{amb}=25°C$

Type number	*Description (positive logic)*	f_c *min. (MHz)*	N_a *min.*	M_L *typ. (V)*	P_{av} *typ. (mW)*	*Package*
FCJ101	Single JK flip-flop	10	8	1.2	36	DIL 14p
FCJ111	Single JK master-slave flip-flop	5	8	1.2	67	DIL 14p
FCJ121	Dual JK master-slave flip-flop	7	8	1.2	50	DIL 14p
FCJ131	Dual JK master-slave flip-flop	7	8	1.2	100	DIL 14p
FCJ141	Decade counter	7	7	1.2	180	DIL 14p
FCJ191	Dual JK master slave flip-flop	7	8	1.2	100	DIL 16p
FCJ201	Single JK master-slave flip-flop	5	8	1.2	67	DIL 14p
FCJ211	Dual JK master-slave flip-flop	7	8	1.2	100	DIL 14p

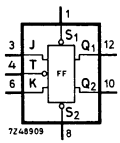
Logic diagrams and terminal connections

FCJ101

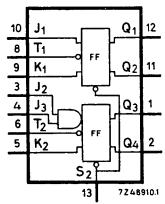


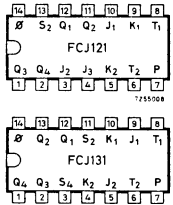


FCJ111



FCJ121





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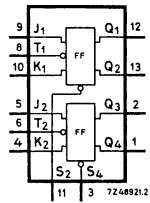

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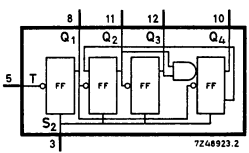
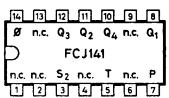
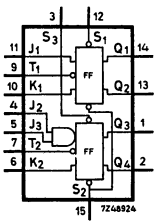
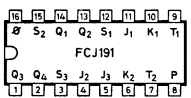


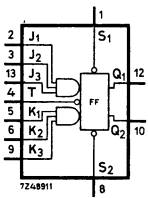


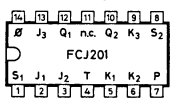
FCJ191





FCJ201





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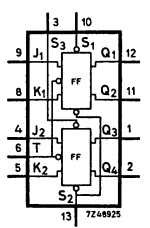
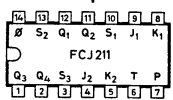




FC family (Diode-Transistor Logic)
Standard temperature range

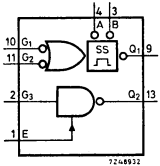
Supply voltage	V_P	6.0 V ± 5%
Operating ambient temperature	T_{amb}	0 to 75°C

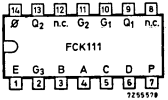
CHARACTERISTICS at $T_{amb} = 25°C$

Type number	*Description (positive logic)*	t_{pd} ($G_1 \rightarrow Q_1$) *typ. (ns)*	t_{pd} ($G_3 \rightarrow Q_3$) *typ. (ns)*	f_c *min. (MHz)*	N_a *min.*	M_L *typ. (V)*	P_{av} *typ. (mW)*	*Package*
FCK111	Monostable multivibrator	70	40	—	14	1.2	58	DIL 14p
FCL101	Level detector (Schmitt trigger)	—	—	1	3	—	19	DIL 14p
		$V_{(BR)R}$ *(V)*	I_R *(μA)*	V_F *(V)*	C_d *(pF)*	t_{rr} *(ns)*		
FCY101	Triple gate input expander (10 diode array)	8	1	1	11	4	—	DIL 14p

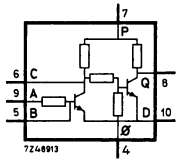
Logic diagrams and terminal connections

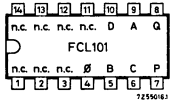
FCK111



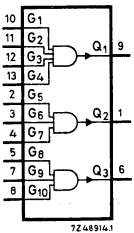


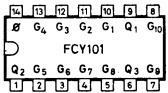
FCL101



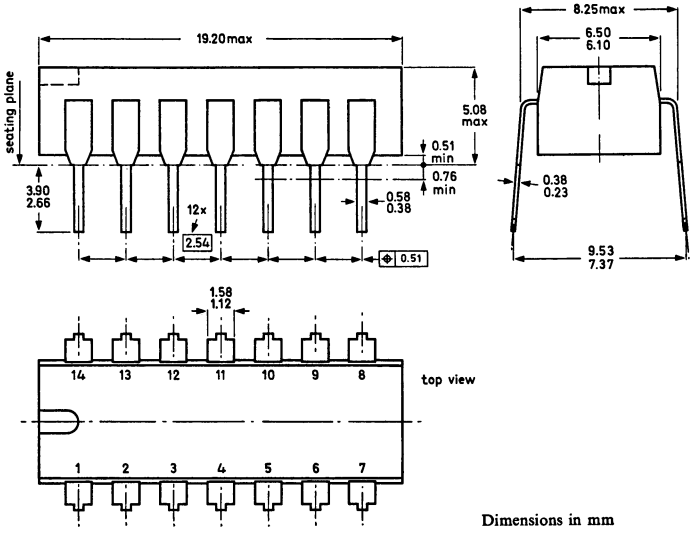


FCY101



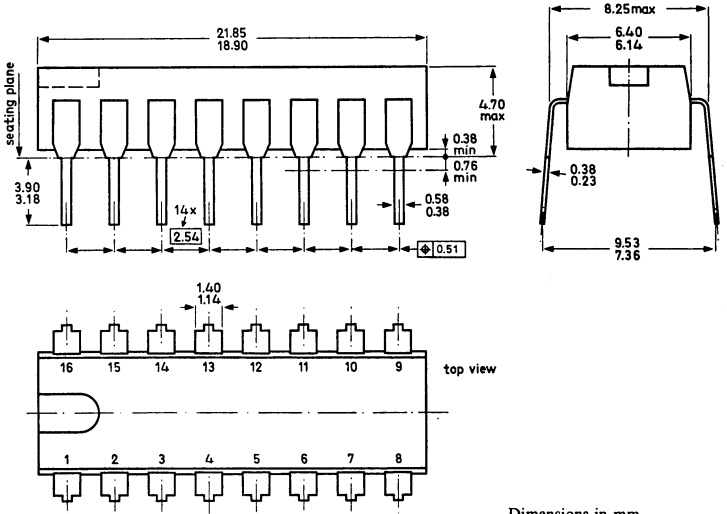


14 pin plastic dual in-line (DIL 14p)



Dimensions in mm

16 pin plastic dual in-line (DIL 16p)

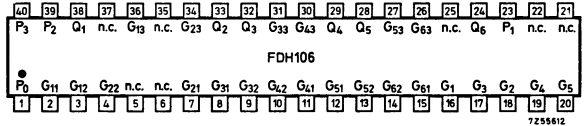


Dimensions in mm

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)
FDH106 Arithmetic/logic array

Supply voltage V_{P1}	−24 to −28 V
Average propagation delay	250 ns
D.C. noise margin	>1 V
Power dissipation	35 mW
Operating ambient temperature	−55 to +85°C



P_0 and metal lid on top of the package are connected

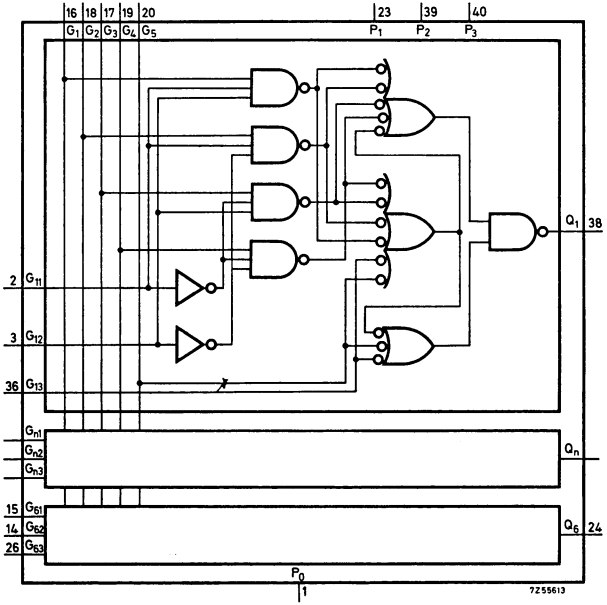
Package: 40 lead ceramic dual in-line

GENERAL DESCRIPTION

The FDH106 consists of six, identical, 3-input gate networks. Five coded control lines determine the function of the six gate networks. Each network may function as a full adder/subtractor, or, if used as a 2-input gate, it can provide all logic functions of 2 variables. Thus one of 32 different functions can be selected by the control lines; the selected function is available six times.

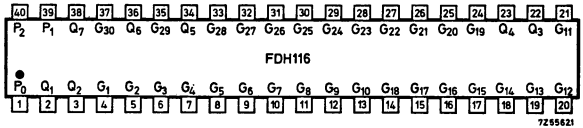
The output voltage swing is determined by the output buffer supply voltage. All inputs are protected against over-voltage caused by static charges.

Inputs G_1 to G_5 have pull-down resistors connected to P_3, so that they assume the LOW state when left floating.


16
18
17
19
20
23
39
40
G1
G2
G3
G4
G5
P1
P2
P3
Q1
38
2
G11
3
G12
36
G13
Gn1
Gn2
Gn3
Qn
15
G61
14
G62
26
G63
Q6
24
P0
1
7Z55613

FD family (MOS)
FDH116 Control logic array

Supply voltage V_{P1}	-24 to -28 V
Average propagation delay	250 ns
D.C. noise margin	>1 V
Power dissipation	150 mV
Operating ambient temperature	-55 to $+85$°C

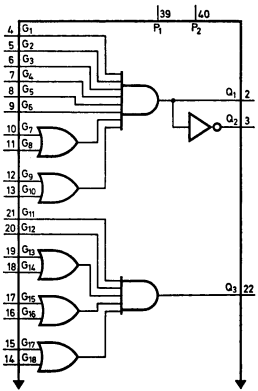


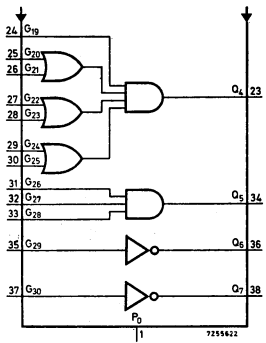
P_0 and metal lid on top of the package are connected

Package: 40 lead ceramic dual in-line

GENERAL DESCRIPTION

The FDH116 contains all the logic functions shown in the diagram and described in the logic function below. It is intended to perform the control logic in all MOS digital systems. The output voltage swing is determined by the output buffer supply voltage. All inputs are protected against over-voltage caused by static charges.

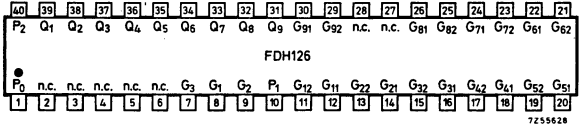

39
40
P1
P2
4 G1
5 G2
6 G3
7 G4
8 G5
9 G6
10 G7
11 G8
12 G9
13 G10
21 G11
20 G12
19 G13
18 G14
17 G15
16 G16
15 G17
14 G18
Q1 2
Q2 3
Q3 22


24 G19
25 G20
26 G21
27 G22
28 G23
29 G24
30 G25
31 G26
32 G27
33 G28
35 G29
37 G30
Q4 23
Q5 34
Q6 36
Q7 38
P0
1
7255622

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)
FDH126 Carry array

Supply voltage V_{P1}	−24 to −28 V
Average propagation delay	250 ns
D.C. noise margin	>1 V
Power dissipation	200 mW
Operating ambient temperature	−55 to −85°C

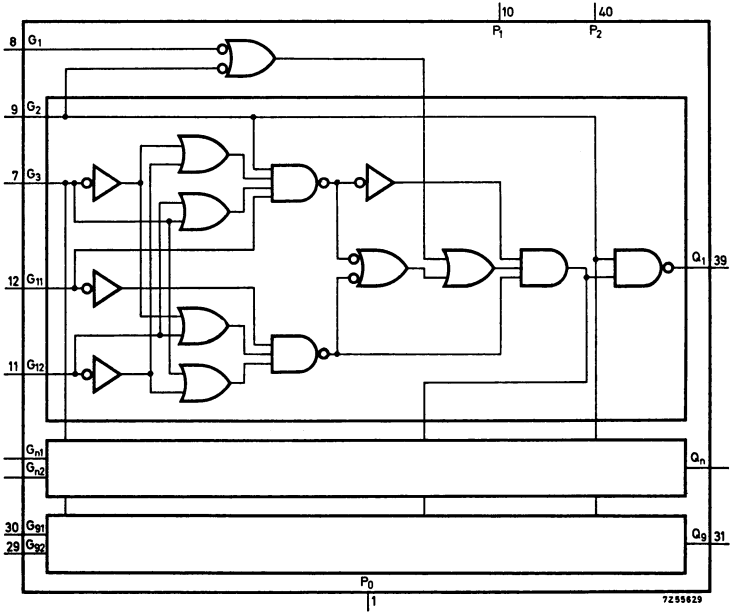


P_0 and metal lid on top of the package are connected

Package: 40 lead ceramic dual in line

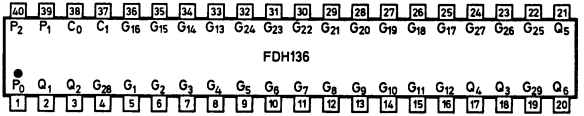
GENERAL DESCRIPTION

The FDH126 contains CARRY propagation circuits for a nine stage binary adder/subtractor. It can be cascaded for longer word lengths. The device is intended to cooperate with the FDH106; e.g. three FDH106 and two FDH126 packages can be put together to make an 18-bit parallel adder/subtractor. By combining all the CARRY circuits in the same package, a very fast CARRY propagation is obtained. All inputs are protected against over-voltage caused by static charges.


10
40
P1
P2
8 G1
9 G2
7 G3
12 G11
11 G12
Q1 39
Gn1
Gn2
Qn
30 G91
29 G92
Q9 31
P0
1
7Z55629

FD family (MOS)
FDH136 AND-OR gating array

Supply voltage V_{P1}	−24 to −28 V
Average propagation delay	180 ns
D.C. noise margin	>1 V
Power dissipation	230 mW
Operating ambient temperature	−55 to +85°C

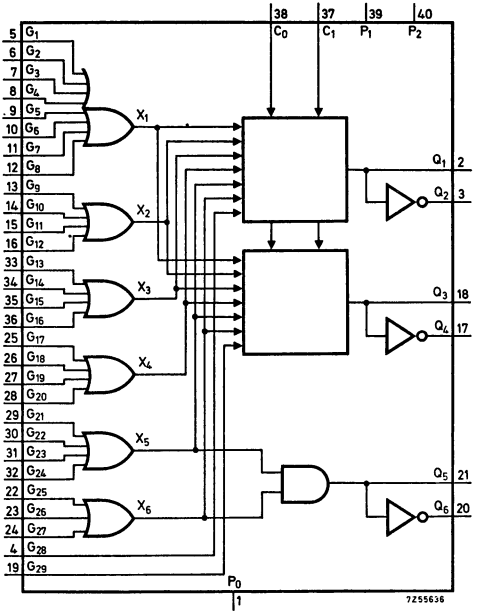


P_0 and metal lid on top of the package are connected.

Package: 40 lead caramic dual in-time

GENERAL DESCRIPTION

The FDH136 contains general purpose, expandable OR/AND/NAND gates.
Two control lines C_0 and C_1 provide four different logic configurations, as shown in the function table.
Complementary outputs are available.
All inputs are protected against over-voltages caused by static charges.

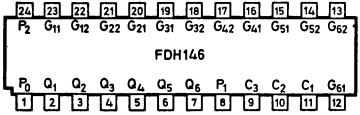

38
37
39
40
C0
C1
P1
P2
5 G1
6 G2
7 G3
8 G4
9 G5
10 G6
11 G7
12 G8
13 G9
14 G10
15 G11
16 G12
33 G13
34 G14
35 G15
36 G16
25 G17
26 G18
27 G19
28 G20
29 G21
30 G22
31 G23
32 G24
22 G25
23 G26
24 G27
4 G28
19 G29
X1
X2
X3
X4
X5
X6
Q1 2
Q2 3
Q3 18
Q4 17
Q5 21
Q6 20
P0
1
7Z55636

B177

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)
FDH146 Variable gate array

Supply voltage V_{P1}	−24 to −28 V
Average propagation delay	250 ns
D.C. noise margin	>1 V
Power dissipation	35 mW
Operating ambient temperature	−55 to +85°C

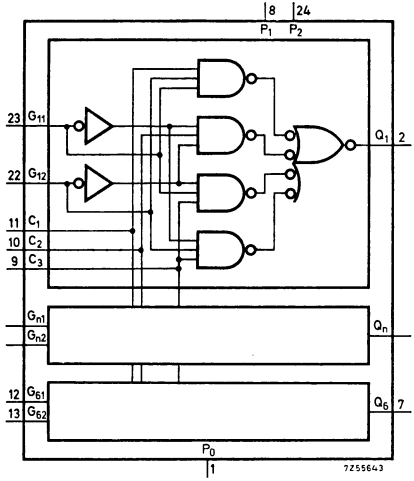


P_0 and metal lid on bottom of the package are connected

Package: 24 lead ceramic dual in-line

GENERAL DESCRIPTION

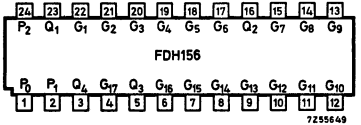
The FDH146 consists of six, identical, 2-input gate networks. Three coded control lines determine the function of the six gate networks, so that eight different functions can be selected; the selected function is available six times.
The control inputs have pull-down resistors connected to P_2, so that they assume the LOW state, when left floating.
All inputs are protected against over-voltage caused by static charges.


8
24
P1
P2
23
G11
22
G12
11
C1
10
C2
9
C3
Q1
2
Gn1
Gn2
Qn
12
G61
13
G62
Q6
7
P0
1
7Z55643

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

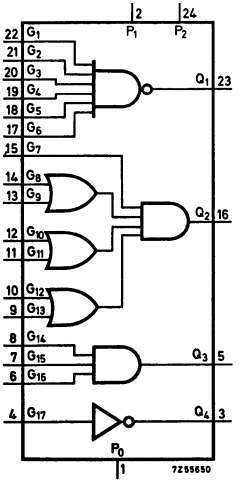
FD family (MOS)
FDH156 Fixed logic array

Supply voltage V_{P1}	−24 to −28 V
Average propagation delay	150 ns
D.C. noise margin	>1 V
Power dissipation	160 mW
Operating ambient temperature	−55 to +85°C



P_0 and metal lid on bottom of the package are connected

Package: 24 lead ceramic dual in-line



GENERAL DESCRIPTION

The FDH156 contains all the logic functions shown in the diagram and described in the logic functions below. It is intended to perform logic functions in all MOS digital systems. The output voltage swing is determined by the output buffer supply voltage (V_{P2}).
All inputs are protected against over-voltage caused by static charges.

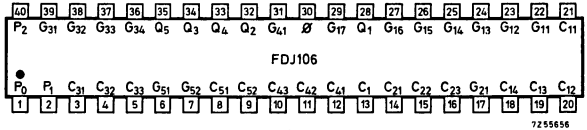
LOGIC FUNCTIONS

Positive logic	*Negative logic*
$Q_1 = \overline{G_1 \cdot G_2 \cdot G_3 \cdot G_4 \cdot G_5 \cdot G_6}$	$Q_1 = \overline{G_1 + G_2 + G_3 + G_4 + G_5 + G_6}$
$Q_2 = G_7 \cdot (G_8 + G_9) \cdot (G_{10} + G_{11}) \cdot (G_{12} + G_{13})$	$Q_2 = G_7 + G_8 \cdot G_9 + G_{10} \cdot G_{11} + G_{12} \cdot G_{13}$
$Q_3 = G_{14} \cdot G_{15} \cdot G_{16}$	$Q_3 = G_{14} + G_{15} + G_{16}$
$Q_4 = \overline{G_{17}}$	$Q_4 = \overline{G_{17}}$

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)
FDJ106 Register array

Supply voltage V_{P1}	−24 to −28 V
Propagation delay	150 ns
D.C. noise margin	>1 V
Power dissipation	180 mW
Operating ambient temperature	−55 to +85°C



P_0 and metal lid on top of the package are connected

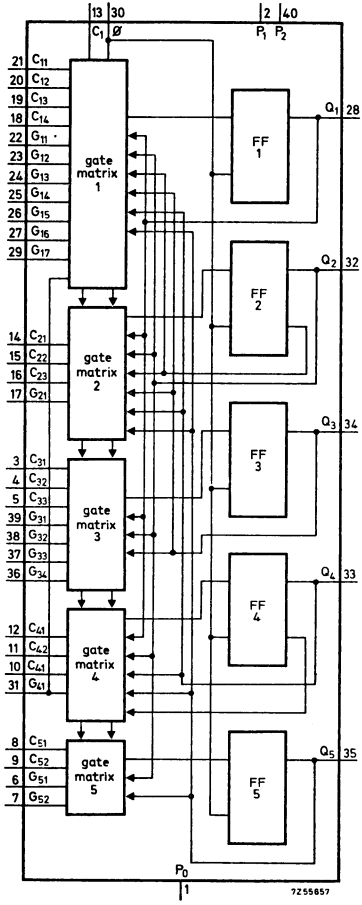
Package: 40 lead ceramic dual in-line

GENERAL DESCRIPTION

The FDJ106 is an array of 5 flip-flops, designed to act as a synchronous bit slice of a CPU.
Each of the 5 D-type flip-flops has at least one external input and output, as well as individually controlled transfer and input SELECT logic.
The input gating matrix can therefore enable transfers from external inputs or from other registers in the same array.
The register array contains one bit of each of the five main registers in most computers:

FF1 – accumulator
FF2 – memory data register
FF3 – multiplier/quotient register
FF4 – program counter
FF5 – instruction register

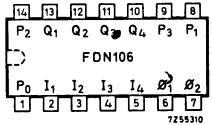
All inputs are protected against over-voltage caused by static charge.

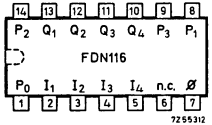

13 30
C1 ø
2 40
P1 P2
21 C11
20 C12
19 C13
18 C14
22 G11
23 G12
24 G13
25 G14
26 G15
27 G16
29 G17
gate matrix 1
FF 1
Q1 28
FF 2
Q2 32
14 C21
15 C22
16 C23
17 G21
gate matrix 2
FF 3
Q3 34
3 C31
4 C32
5 C33
39 G31
38 G32
37 G33
36 G34
gate matrix 3
FF 4
Q4 33
12 C41
11 C42
10 C41
31 G41
gate matrix 4
8 C51
9 C52
6 G51
7 G52
gate matrix 5
FF 5
Q5 35
P0
1
7Z55857

FD family (MOS)

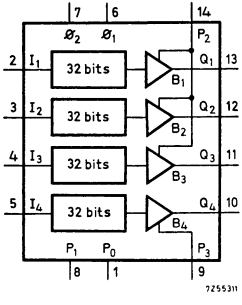
SHIFT REGISTERS (metal ceramic DIL 14p)

Supply voltage	−24 to −28 V
D.C. noise margin	>1 V
Clock rate (2 Phase)	0.01 MHz to 3 MHz
Clock rate (1 Phase)	0.01 MHz to 1 MHz
Power dissipation	300 mW
Operating ambient temperature	−55 to +85°C

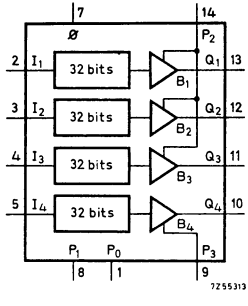




FDN106 Quadruple 32-bit dynamic shift register (2-Phase)



FDN116 Quadruple 32-bit dynamic shift register (1-Phase)



GENERAL DESCRIPTION

The FDN106 and FDN116 packages comprise 4 separate 32-bit shift registers that can be used independently or can be externally connected to make registers up to 128-bits long. Clock and power lines are common to all four registers. The output buffers are bi-directional, low impedance NRZ[1]), that by suitable biasing will directly drive MOS, DTL or TTL loads or, because they have separate supply voltages (V_{P2}; V_{P3}), a combination of MOS and bipolar. V_{P2} and V_{P3} are output buffer voltages only, so the output LOW signal is independent of the width and amplitude of the clock pulse.

The FDN106 uses a two-phase external clock, has low power dissipation and will operate at high speed.

The FDN116 uses a single phase external clock, and is for applications not calling for the low power economy and high speed of the FDN106.

With the FDN106; FDN116; the FDN126; FDN136 (variable length 1 to 64-bit dynamic shift registers) and the FDN146; FDN156 (256-bit dynamic shift registers) shift registers of any length can be built from off-the-shelf parts.

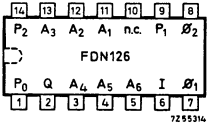
[1]) Non return to zero

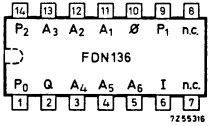
DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)

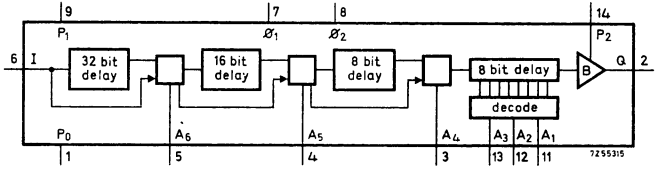
SHIFT REGISTERS (metal ceramic DIL 14p)

Supply voltage	−24 to −28 V
D.C. noise margin	>1 V
Clock rate (2 Phase)	0.01 MHz to 3 MHz
Clock rate (1 Phase)	0.01 MHz to 1 MHz
Power dissipation	300 mW
Operating ambient temperature	−55 to +85°C

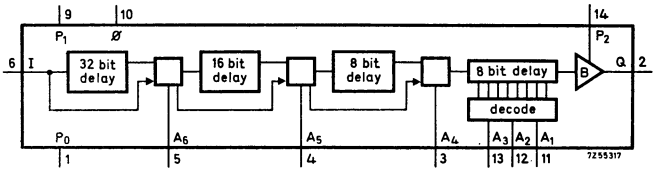




FDN126 Variable length 1 to 64 bit dynamic shift register (2-Phase).



FDN136 Variable length 1 to 64 bit dynamic shift register (1-Phase).



GENERAL DESCRIPTION

The FDN126 and FDN136 are unique in that the bit length of both registers can be set from 1 to 64 bits by appropriate choice of the logic state of 6 control inputs. The same input and output leads are used, the control inputs determine the number of register stages connected between them.

The FDN126 is essentially for high speed operation and needs a 2 phase external clock.

The FDN136 needs only a low level single phase external clock; it is suitable for applications that do not demand speeds in excess of 1 MHz.

Both circuits use a bi-directional low impedance output buffer which, when appropriately biased, is capable of driving MOS or DTL and TTL loads direct.

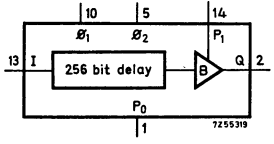
With the FDN126; FDN136, the FDN106; FDN116 (quadruple 32-bit dynamic shift registers) and FDN146; FDN156 (256 bit dynamic shift registers) shift registers of exactly the right length can be built from off-the-shelf parts.

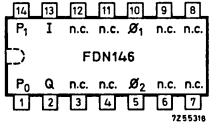
DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)

FDN146 256-bit dynamic shift register (2-Phase) (metal ceramic DIL 14p)

Supply voltage	−24 to −28 V
D.C. noise margin	>1 V
Clock rate (2-Phase)	0.01 to 3 MHz
Power dissipation	300 mW
Operating ambient temperature	−55 to +85°C



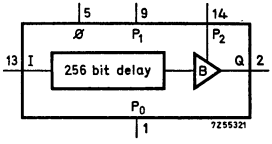


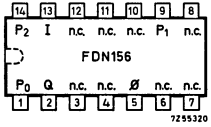
GENERAL DESCRIPTION

The FDN146 contains one continuous 256-bit shift register with one serial input and one serial output. It dissipates very little power and uses a two-phase external clock. The device has a low impedance push-pull output buffer which, when appropriately biased is capable of interfacing direct with MOS, DTL, TTL and other loads. The buffer supply terminal P_1 is a separate supply which determines the output LOW signal only. This provides an output level that is independent of both the amplitude and width of the clock pulse. With the FDN146, the FDN106 (a quadruple 32-bit shift register) and FDN126 (a variable length 1 to 64 bit shift register) shift registers of exactly the right length can be built from off-the-shelf parts.

FDN156 256-bit dynamic shift register (1-Phase) (metal ceramic DIL 14p)

Supply voltage	−26 to −28 V
D.C. noise margin	>1 V
Clock rate (1-Phase)	0.01 to 1 MHz
Power dissipation	800 mW
Operating ambient temperature	−55 to −85°C





GENERAL DESCRIPTION

The FDN156 contains one 256-bit shift register with one serial input and one serial output. It dissipates very little power and uses a one-phase external clock. The device has a low impedance push-pull output buffer which, when appropriately biased is capable of interfacing direct with MOS, DTL, TTL and other loads.

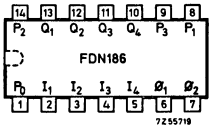
The buffer supply terminal P_2 is a separate supply which determines the output LOW signal only. This provides an output level that is independent of both the amplitude and width of the clock pulse.

With the FDN156, the FDN116 (a quadruple 32-bit shift register) and FDN136 (a variable length 1 to 64-bit shift register) shift registers of any length can be built from off-the-shelf parts.

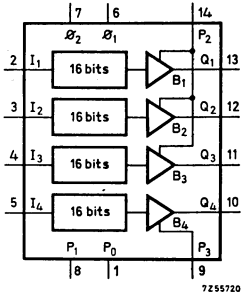
FD family (MOS)

FDN186 Quadruple 16-bit dynamic shift register

Supply voltage V_{P1}	−24 to −28 V
D.C. noise margin	>1 V
Clock rate	0.01 to 3 MHz
Power dissipation	800 mW
Operating ambient temperature	−55 to +85°C



14 lead metal-ceramic dual in-line



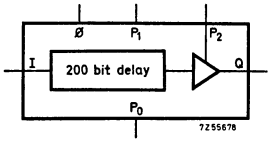
GENERAL DESCRIPTION

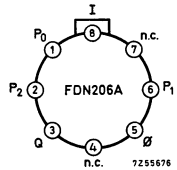
The FDN186 package comprises 4 separate 16-bit shift registers that can be used independently or can be externally connected to make registers up to 64-bits long. Clock and power lines are common to all four registers. The output buffers are bi-directional, low impedance NRZ[1]), that by suitable biasing will directly drive MOS, DTL or TTL loads or, because they have separate output voltages (V_{P2}, V_{P3}), a combination of MOS and bipolar. V_{P2} and V_{P3} are output buffer voltages only, and the output signal is independent of the width and amplitude of the clock pulse.

[1]) Non-return to zero

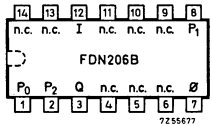
200-bit dynamic shift register

Supply voltage	−26 to −28 V
D.C. noise margin	>1 V
Clock rate (1-Phase)	0.01 to 1 MHz
Power dissipation FDN206A:	625 mW
FDN206B:	800 mW
Operating ambient temperature	−55 to +85°C





FDN206A: TO-99



FDN206B: metal ceramic DIL 14p

GENERAL DESCRIPTION

The FDN206 contains one 200-bit shift register with one serial input and one serial output. It dissipates very little power and uses a one-phase external clock. The device has a low impedance push-pull output buffer which, when appropriately biased is capable of interfacing direct with MOS, TTL and other loads.

The buffer supply terminal P_2 is a separate supply which determines the output LOW signal only. This provides an output level that is independent of both the amplitude and width of the clock pulse.

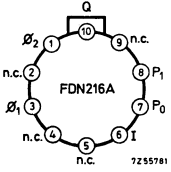
With the FDN206, the FDN116 (a quadruple 32-bit shift register) and FDN136 (a variable length 1 to 64-bit shift register) shift registers of any required length can be built from off-the-shelf parts.

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)
FDN216A; FDN216B

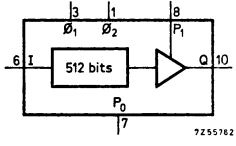
512-bit dynamic shift registers

Supply voltage V_{P1}:	-12 to -14 V
D.C. noise margin	>1 V
Clock rate	0.01 to 3 MHz
Power dissipation	625 mW
Power consumption	0.36 mW
Operating ambient temperature	-55 to $+85$°C



top view

FDN216A: TO-100



GENERAL DESCRIPTION

The FDN216A is a 512-bit 2-phase dynamic shift register.

The device has a low impedance push-pull output buffer.

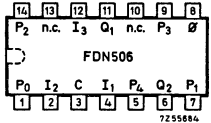
The device offers a direct compatible pin configuration for users who have already designed their system using the FDN146A (a single 256-bit dynamic serial shift register).

Note: The FDN216B is the same device in a 14 lead dual in-line.

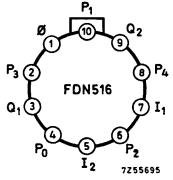
FD family (MOS)
FDN506; FDN516

Dual 32-bit static registers

Supply voltages V_{P1}:	−24 to −28 V
V_{P2}:	−12 to −14 V
D.C. noise margin	>1 V
Clock rate (1-Phase)	0 to 1.5 MHz
Power dissipation FDN506:	800 mW
FDN516:	625 mW
Operating ambient temperature	−55 to +85°C

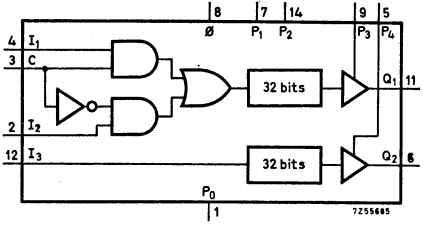


FDN506: metal ceramic DIL 14p

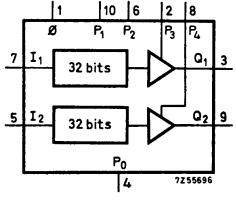


FDN516: TO-100

FDN506



FDN516



GENERAL DESCRIPTION

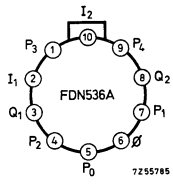
The FDN506 and FDN516 are dual 32-bit static shift registers. They require a single phase, low voltage, external clock signal, and may be operated down to d.c. without loss of stored information. Both devices utilize common power and clock lines; the output buffer supplies are separated to facilitate independent biasing for MOS or TTL load drive.
The FDN506 contains the gating, external SELECT command and data inputs for selection of two independent data streams.

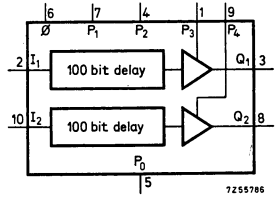
DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)
FDN536A; FDN536B

Dual 100-bit static shift register

Supply voltages V_{P1}	-24 to -28 V
V_{P2}; V_{P3}; V_{P4}	-12 to -14 V
D.C. noise margin	>1 V
Clock rate (1-phase)	0 to 1.5 MHz
Power dissipation	625 mW
Power consumption	1 mW
Operating ambient temperature	-55 to $+85$°C





GENERAL DESCRIPTION

The FDN536A is a monolithic dual 100-bit shift register. The two shift registers have each one serial input and output. They operate from common clocks and supply lines. The device has low impedance push-pull output buffers, which, when appropriately biased, are capable of interfacing direct with MOS, TTL, DTL and other loads.

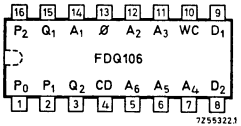
The buffer supply terminals P_3 and P_4 are separate supplies which determine the output LOW signals only. This provides an output level that is independent of supply voltages V_{P1}, V_{P2}, the amplitude and width of the clock pulses.

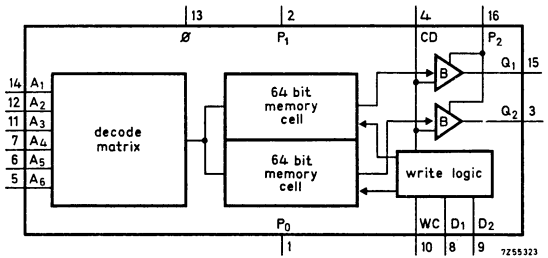
All inputs, outputs, supply terminals and clock inputs are protected against static voltages.

Note: FDN536B is the same device in a 14 lead dual in-line.

FDQ106 (metal ceramic DIL 16p)
Read/write random access memory,
128-bit, 64 word, 2-bits per word

Supply voltage	−24 V to −28 V
Standby power per bit	3 μW
Power consumption per bit	135 mW
Read access time	max. 1 μs
D.C. noise margin	min. 1 V
Max. data read rate	1 MHz
Max. data write rate	1 MHz
Operating ambient temperature	−55 to +85°C





GENERAL DESCRIPTION

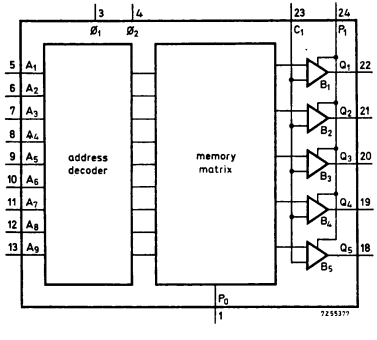
The FDQ106 is a monolithic, 128-bit random access/write memory. It is organized as two 64-bit memories with 6 common single-rail address inputs and two separate outputs; it is used as a 64 word, 2-bits per word memory. It requires a single-phase clock strobe pulse to refresh the data stored in all the memory cells simultaneously and to change the data stored in a cell in the write mode.
It also incorporates a chip disable that inhibits both data inputs and output buffers for expanded memory applications. The memory is activated in the write mode by applying a write control pulse; at all other times it is in the read mode.

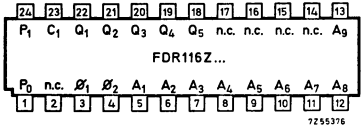
DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)

FDR116Z } Read only memory, 512 word,
FDR116Z1 } 5-bits per word

Read acces time	max. 850 ns
Clock rate	max. 1.2 MHz
Power dissipation	36 mW
D.C. noise margin	> 1 V
Operating ambient temperature	− 55 to + 85°C





Metal ceramic DIL 24p

FDR116Z... 512 words 5 bits/word (no discrete content).
FDR116Z1 512 words 5 bits/word (fixed bit pattern).

GENERAL DESCRIPTION

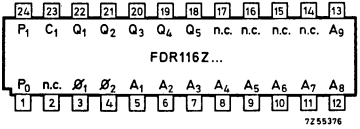
The FDR116Z is a monolithic 2560-bit read only memory. When ordering an FDR116Z the customer must send a bit pattern matrix with the desired content. For performance evaluation, we can supply specimens of FDR116Z1, which is identical to the FDR116Z but contains a bit pattern of our own. The FDR116Z requires a two phase clock, but the outputs remain steady as long as the address remains unchanged. The normal configuration is as a 512 word, 5-bits per word, parallel output ROM. An output inhibit control allows the use of multiple FDR116Z in a wired-OR configuration.

The memory matrix is programmed with the aid of a mask pattern during manufacture. The only d.c. supply is the output buffer supply, which is variable and can be biased to drive bipolar output loads direct.

FD family (MOS)
FDR116Z2

Character generator (5 × 7 dot matrix; row scan system)

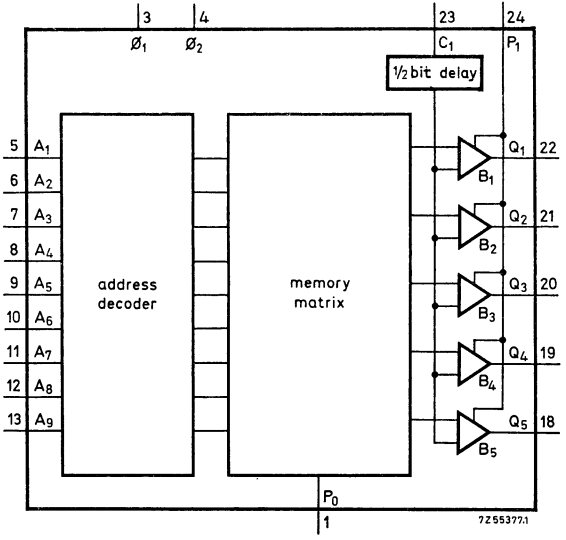
Read access time	max. 850 ns
Clock rate	max. 1.2 MHz
Power dissipation	90 mW
D.C. noise margin	> 1 V
Operating ambient temperature	−55 to +85°C



P_0 and metal package bottom are connected
24 lead metal-ceramic dual in-line

GENERAL DESCRIPTION

The FDR116Z2 is a pre-programmed specimen of the FDR116Z.
It is intended for use as character generator in display systems, using a 5 × 7 dot matrix, where the characters are built-up with one horizontal row at a time.
The device contains a sub-set of the ASCII character set viz. the lower case symbols and a pictorial representation of the control symbols.
When the device is used in combination with the FDR116Z1, the full 7-bit ASCII code character set can be displayed.


3
4
23
24
Ø1
Ø2
C1
P1
½ bit delay
5 A1
6 A2
7 A3
8 A4
9 A5
10 A6
11 A7
12 A8
13 A9
address decoder
memory matrix
B1
B2
B3
B4
B5
Q1 22
Q2 21
Q3 20
Q4 19
Q5 18
P0
1
7Z55377.1

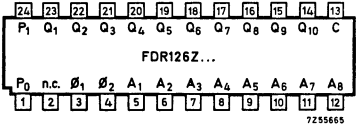
DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)

FDR126Z } Read only memory, 256 word,
FDR126Z1 } 10 bits per word

Read access time	max. 1 μs
Clock rate	max. 1 MHz
Power dissipation	100 mW
D.C. noise margin	>1 V
Operating ambient temperature	−55 to +85°C

24 lead metal-ceramic dual in-line



P_0 and metal package bottom are connected

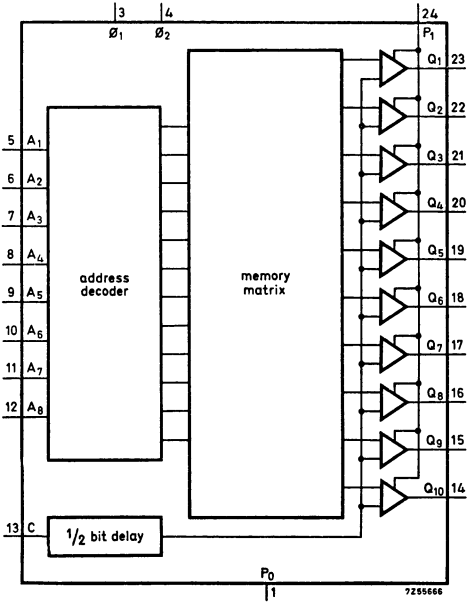
GENERAL DESCRIPTION

The FDR126Z is a monolithic 2560-bit read only memory. When ordering an FDR126Z the customer must send a bit pattern matrix with the desired content. For performance evaluation, we can supply specimens of FDR126Z1, which is identical to the FDR126Z but contains a bit pattern of our own. The FDR126Z requires a two phase clock; the outputs remain steady as long as the address remains unchanged. The memory matrix is programmed with the aid of a mask pattern during manufacture. The only d.c. supply is the output buffer supply, which is variable and can be biased to drive bipolar output loads direct.

The FDR126Z1 is a pre-programmed version of the FDR126Z READ-ONLY memory. It is intended to convert from ASCII to SELECTRIC line code and vice versa.

When 7-bit address of either code is applied to the inputs of the ROM, the corresponding 7-bits of the other code will appear at the outputs. The three remaining outputs are used for parity and control code indications.

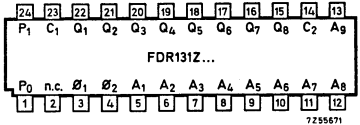
The electrical characteristics of the FDR126Z1 are equal to those of the FDR126Z.


3
4
24
Ø1
Ø2
P1
Q1 23
Q2 22
Q3 21
Q4 20
Q5 19
Q6 18
Q7 17
Q8 16
Q9 15
Q10 14
5 A1
6 A2
7 A3
8 A4
9 A5
10 A6
11 A7
12 A8
address decoder
memory matrix
13 C
1/2 bit delay
P0
1
7265666

FD family (MOS)

FDR131Z } Read only memory, 512 word,
FDR131Z1 } 8 bits per word

Read access time	max. 1.5 μs
Clock rate	max. 1 MHz
Power dissipation (MOS load)	100 mW
D.C. noise margin	>1 V
Operating ambient temperature	0 to +70°C

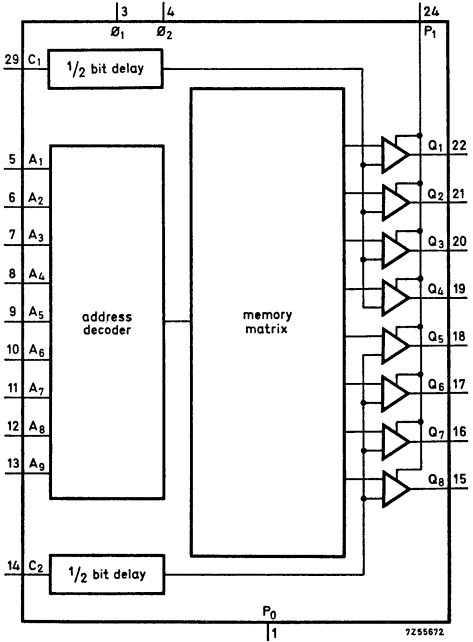


P_0 and metal package bottom are connected

24 lead metal-ceramic dual in-line

GENERAL DESCRIPTION

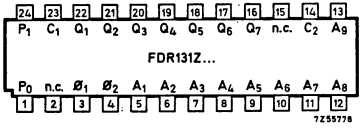
The FDR131Z is a monolithic 4096-bit READ-only memory (ROM) with a capacity of 512 words, 8-bits per word. With two output-inhibit control lines C_1 and C_2 it can also operate as a 1024-word, 4-bits per word memory. The memory matrix is given the desired content by means of a special mask. When ordering, customers have to complete a set of forms specifying the bit pattern to be associated with each address. An output-inhibit control makes it possible to use several FDR131Z memories in wired-OR configuration.
The only d.c. supply is the output buffer supply (P_1), which may be adapted to interface direct with either MOS or bipolar DTL/TTL. The inputs of the FD circuits are effectively protected against over voltage caused by static charge.


3
4
24
Ø1
Ø2
P1
29 C1
1/2 bit delay
5 A1
6 A2
7 A3
8 A4
9 A5
10 A6
11 A7
12 A8
13 A9
address decoder
memory matrix
Q1 22
Q2 21
Q3 20
Q4 19
Q5 18
Q6 17
Q7 16
Q8 15
14 C2
1/2 bit delay
P0
1
7Z55672

FD family (MOS)
FDR131Z2

Character generator (5 × 7 dot matrix; column scan type)

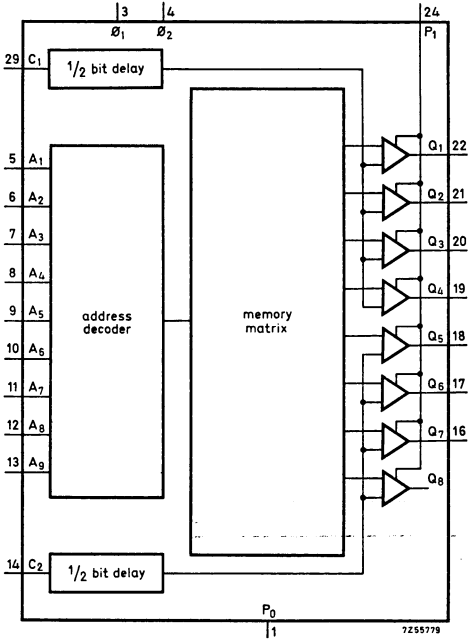
Read access time	max. 1.5 μs
Clock rate	max. 0.67 MHz
Power dissipation	90 mW
D.C. noise margin	>1 V
Operating ambient temperature	0 to +70°C



P_0 and metal lid on bottom of the package are connected
24 lead metal-ceramic dual in-line

GENERAL DESCRIPTION

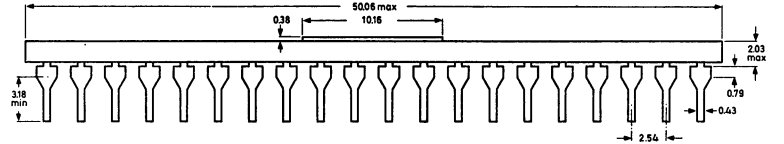
The FDR131Z2 is a pre-programmed version of the FDR131Z.
It is intended for use as alphanumeric character generator in display systems, using a 5 × 7 dot matrix, where the characters are built-up column-wise. The CHARACTER SELECT inputs (A_4 to A_9) accept a six bit ASCIIcode, for the COLUMN SELECT inputs (A_1 to A_3) a three bit binary number is required, which is internally decoded. Each 7-bit word appears in parallel on the 7 outputs.

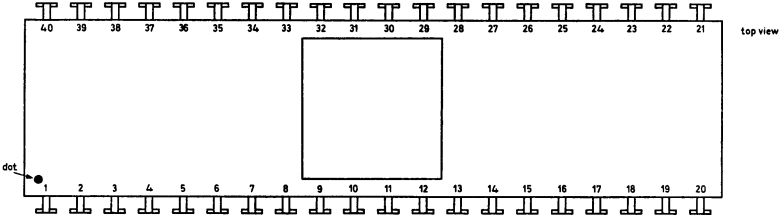

3
4
24
Ø1
Ø2
P1
29 C1
1/2 bit delay
5 A1
6 A2
7 A3
8 A4
9 A5
10 A6
11 A7
12 A8
13 A9
address decoder
memory matrix
Q1 22
Q2 21
Q3 20
Q4 19
Q5 18
Q6 17
Q7 16
Q8
14 C2
1/2 bit delay
P0
1
7Z55779

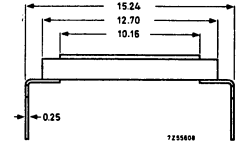
DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FD family (MOS)

Package outline 40 lead metal-ceramic dual in-line



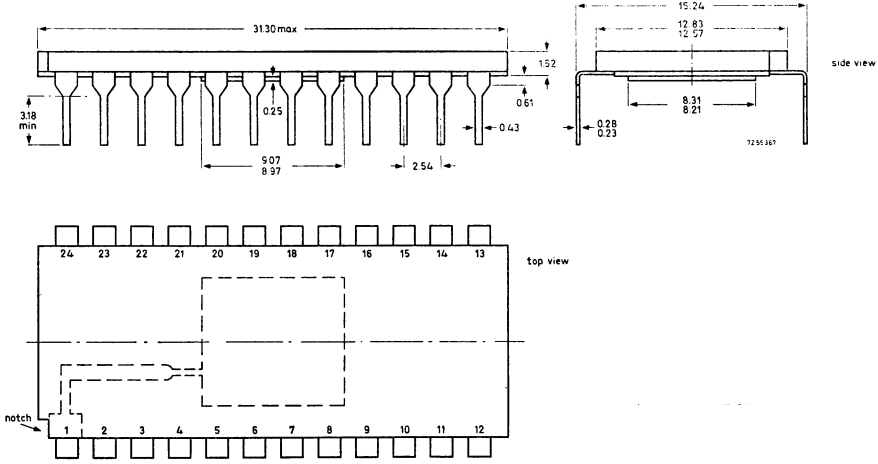




Notes

1. Leads on opposite sides are designed to fit in holes 15.24 mm apart.
2. Pin 1 is marked by a dot and connected to the metal lid on top of the package.
3. Dimensions in mm.

Metal ceramic 24 pin dual in-line

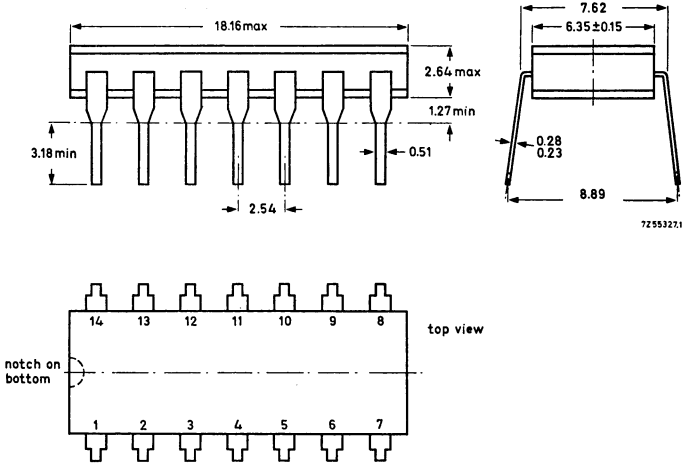


Dimensions in mm

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

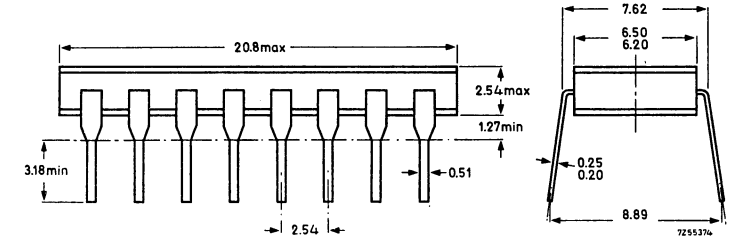
FD family (MOS)

Metal ceramic 14 pin dual in-line



Dimensions in mm

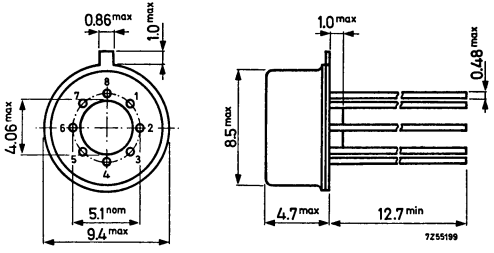
Metal ceramic 16 pin dual in-line



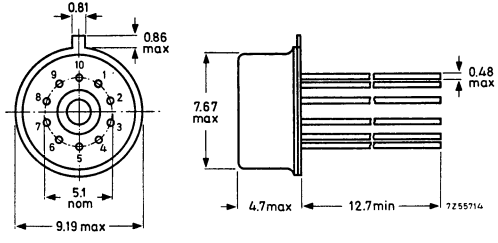
Dimensions in mm

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FDN206A
TO-99 metal envelope



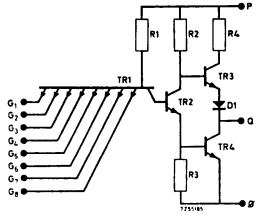
FDN516
TO-100 metal envelope



DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FJ family (Transistor-Transistor Logic)
Standard temperature range

Supply voltage	V_P	5.0 V ± 5%
Operating ambient temperature	T_{amb}	0 to 70°C



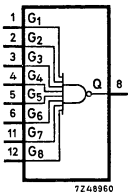
Basic gate circuit

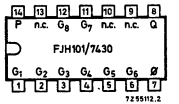
CHARACTERISTICS at $T_{amb} = 25°C$ (each gate)

Type number	*Description (positive logic)*	t_{pd} *typ. (ns)*	N_a *min.*	M_L *typ. (V)*	P_{av} *typ. (mW)*	*Package*
FJH101/7430	Single 8-input NAND gate	13	10	1.0	10	DIL 14p
FJH111/7420	Dual 4-input NAND gate	13	10	1.0	10	DIL 14p
FJH121/7410	Triple 3-input NAND gate	13	10	1.0	10	DIL 14p
FJH131/7400	Quadruple 2-input NAND gate	13	10	1.0	10	DIL 14p
FJH141/7440	Dual 4-input NAND power gate	13	30	1.0	26.5	DIL 14p
FJH151/7450	Dual expandable 2+2-input AND-OR-NOT gate	13	10	1.0	14.25	DIL 14p
FJH161/7451	Dual 2+2-input AND-OR-NOT gate	13	10	1.0	14.25	DIL 14p

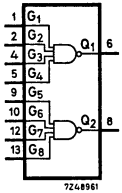
Logic diagrams and terminal connections

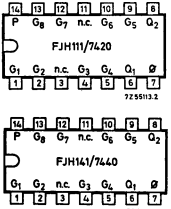
FJH101/7430



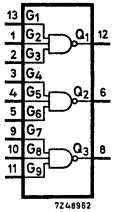


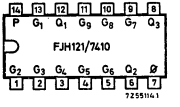
FJH111/7420
FJH141/7440



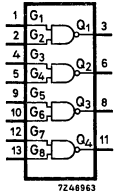


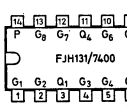
FJH121/7410



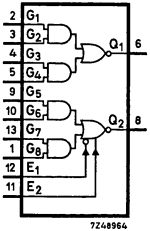


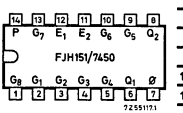
FJH131/7400



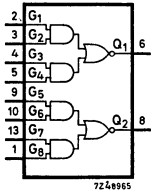


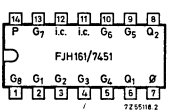
FJH151/7450





FJH161/7451



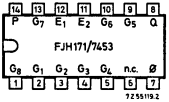


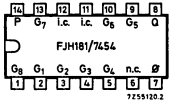
Pin 14 = P = positive supply voltage; pin 7 = Ø = earth

DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FJ family (Transistor-Transistor Logic)
Standard temperature range

Supply voltage	V_P	5.0 V ± 5%
Operating ambient temperature	T_{amb}	0 to 70°C



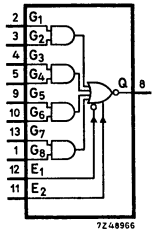


CHARACTERISTICS at T_{amb} = 25°C (each gate)

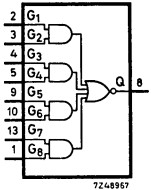
Type number	*Description (positive logic)*	t_{pd} *typ. (ns)*	N_a *min.*	M_L *typ. (V)*	P_{av} *typ. (mW)*	*Package*
FJH171/7453	Expandable 2+2+2+2 input AND-OR-NOT gate	13	10	1.0	14.25	DIL 14p
FJH181/7454	2+2+2+2 input AND-OR-NOT gate	13	10	1.0	14.25	DIL 14p
FJH191/7480	Full adder	—	5	1.0	105	DIL 14p
FJH221/7402	Quadruple 2-input NOR gate	13	10	1.0	14.25	DIL 14p
FJH231/7401	Quadruple 2-input NAND gate	22	10	1.0	7.5	DIL 14p
FJH241/7404	Sextuple 1-input inverter	13	10	1.0	10	DIL 14p
FJH251/7405	Sextuple 1-input inverter	13	10	1.0	10	DIL 14p
FJH261/7442	BCD-to-decimal decoder	20	10	—	140	DIL 16p
FJH291/7403	Quadruple 2-input NAND gate	22	10	1.0	7.5	DIL 14p

Logic diagrams and terminal connections

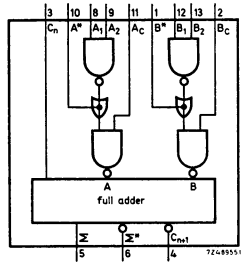
FJH171/7453



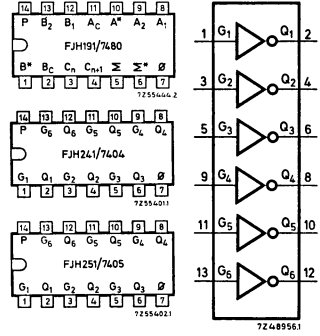
FJH181/7454



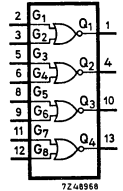
FJH191/7480



FJH241/7404
FJH251/7405



FJH221/7402



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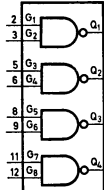
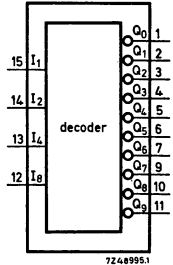
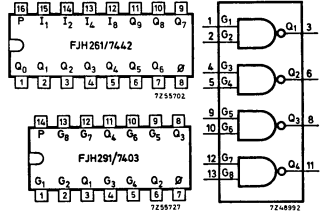


FJH261/7442

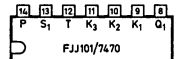


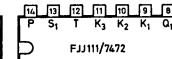
FJH291/7403

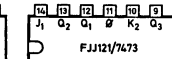


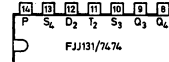
FJ family (Transistor-Transistor Logic)
Standard temperature range

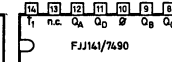
Supply voltage	V_P	5.0 V ± 5%
Operating ambient temperature	T_{amb}	0 to 70°C

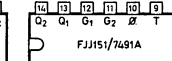










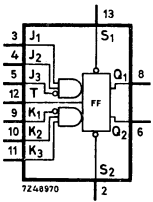


CHARACTERISTICS at $T_{amb} = 25°C$

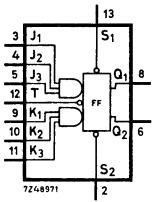
Type number	*Description (positive logic)*	f_c *min. (MHz)*	N_a *min.*	M_L *typ. (V)*	P_{av} *typ. (mW)*	*Package*
FJJ101/7470	Single JK flip-flop	20	10	–	70	DIL 14p
FJJ111/7472	Single JK master-slave flip-flop	10	10	–	40	DIL 14p
FJJ121/7473	Dual JK master-slave flip-flop	10	10	–	40	DIL 14p
FJJ131/7474	Dual D-type edge-triggered flip-flop	15	10	–	42.5	DIL 14p
FJJ141/7490	BCD decade counter	10	10	–	160	DIL 14p
FJJ151/7491A	8-bit shift register	10	10	1.0	175	DIL 14p
FJJ181/7475	Quadruple gated D flip-flop	–	10	1.0	160	DIL 16p

Logic diagrams and terminal connections

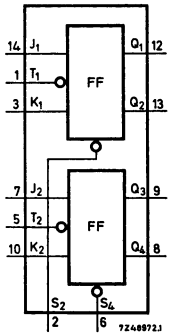
FJJ101/7470



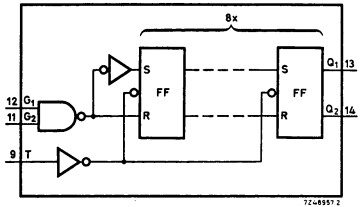
FJJ111/7472



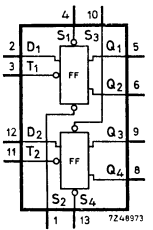
FJJ121/7473



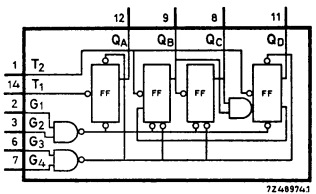
FJJ151/7491A



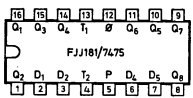
FJJ131/7474

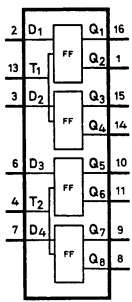


FJJ141/7490



FJJ181/7475

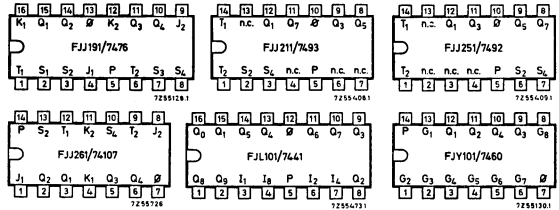




DIGITAL MONOLITHIC INTEGRATED CIRCUITS

FJ family (Transistor-Transistor Logic)
Standard temperature range

Supply voltage	V_P	5.0 V ± 5%
Operating ambient temperature	T_{amb}	0 to 70°C

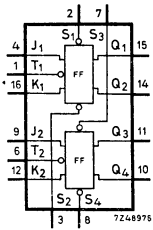


CHARACTERISTICS at $T_{amb} = 25°C$

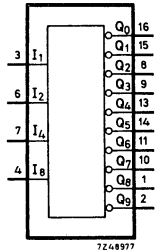
Type number	*Description (positive logic)*	f_c *min. (MHz)*	N_a *min.*	M_L *typ. (V)*	P_{av} *typ. (mW)*	*Package*
FJJ191/7476	Dual JK master-slave flip-flop	10	10	1.0	80	DIL 16p
FJJ211/7493	Single decoded NIT driver	–	–	–	100	DIL 14p
FJJ251/7492	Single asynchronous 4-bit binary counter	10	10	1.0	155	DIL 14p
FJJ261/74107	Dual JK master-slave flip-flop	10	10	—	40	DIL 14p
FJL101/7441	Single asynchronous 4-bit binary counter	10	10	1.0	128	DIL 16p
FJY101/7460*	Dual 4-input AND-OR-NOT expander			1.0	4.0	DIL 14p

Logic diagrams and terminal connections

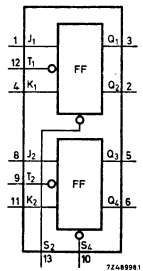
FJJ191/7476



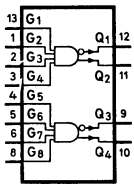
FJL101/7451



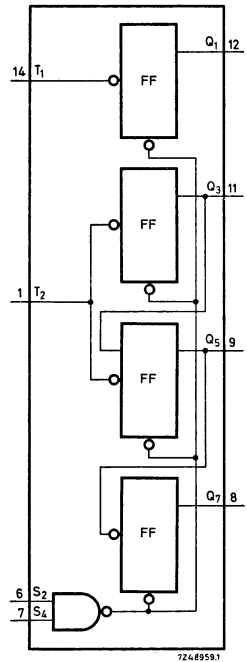
FJJ261/74107



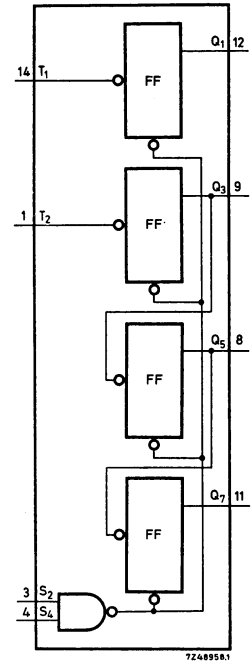
FJY101/7460



FJJ211/7493



FJJ251/7492



* Propagation delay time typ. 15ns.

LINEAR MONOLITHIC INTEGRATED CIRCUITS

CHARACTERISTICS at $T_{amb} = 25°C$.

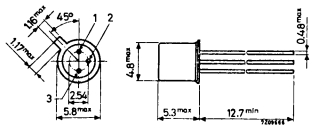
Audio amplifiers

Type number	G_{tr}	Z_i	R_L	f_c	P_o	V_o	P_{tot}	V_P	*Package*
TAA263	77 dB				>10 mW	<7 V	<70 mW	8 V	TO-72
TAA300*		15 kΩ	8 Ω	20 kHz	1 W		0.8 W	9 V	TO-74
TAA310	100 dB	20 kΩ		15 kHz		2 V	160 mW	7 V	TO-74
TAA435**	80 dB	70 kΩ		10 kHz	>4 W			14 V	TO-74

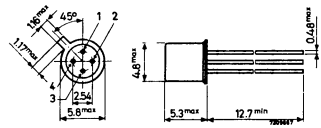
TAA320 MOST pre-amplifier in TO-18 package

Drain-source voltage	max. 20 V
Drain current	max. 25 mA
Gate-source voltage	typ. 11 V
Gate-source resistance	min. 100 GΩ
Transfer admittance	typ. 75 Ω^{-1}

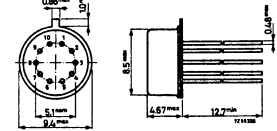
* Input signal for 1 W output = typ. 8.5 mV.
** Audio pre-amplifier and driver.



TO-18

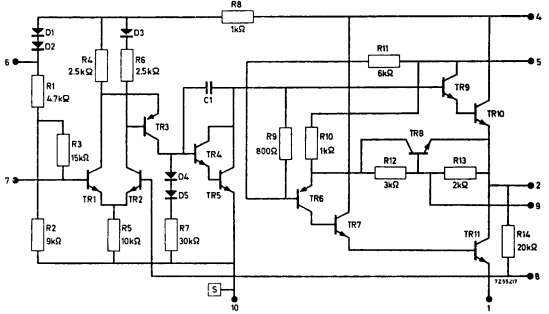


TO-72

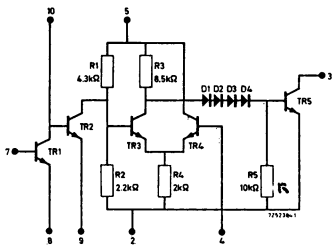


TO-74 (reduced height)

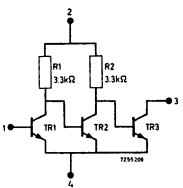
TAA300



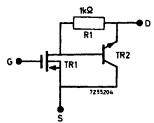
TAA310



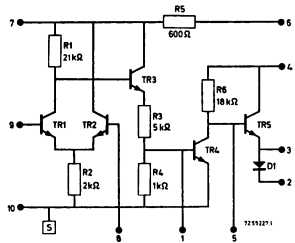
TAA263



TAA320



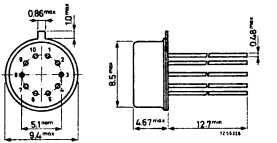
TAA435



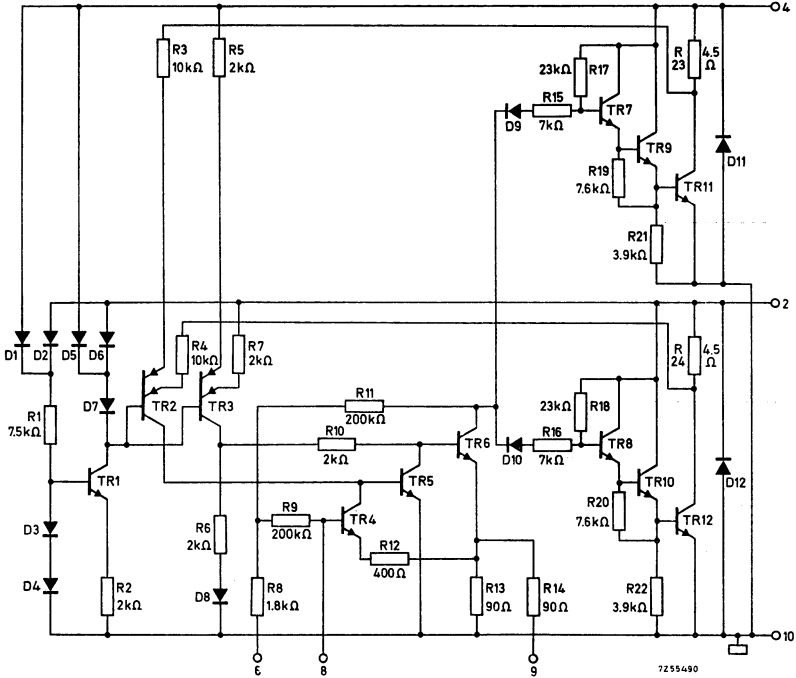
Audio amplifiers

TAA970 Microphone amplifier (TO-74)

Supply voltage	±4.8 V	
Supply current	±10 to ±100 mA	
Voltage gain	130	pin 9 not connected
Output impedance	80 Ω	
Voltage gain	180	pin 9 connected to pin 10
Output impedance	115 Ω	



TO-74 (reduced height)


4
2
10
R3
10kΩ
R5
2kΩ
23kΩ
R17
R
23
4.5
Ω
R15
7kΩ
D9
TR7
TR9
D11
R19
7.6kΩ
TR11
R21
3.9kΩ
D1
D2
D5
D6
R4
10kΩ
R7
2kΩ
R
24
4.5
Ω
D7
TR2
TR3
R11
200kΩ
23kΩ
R18
R1
7.5kΩ
R10
2kΩ
TR6
D10
R16
7kΩ
TR8
TR1
TR5
TR10
D12
R20
7.6kΩ
D3
R6
2kΩ
R9
200kΩ
TR4
TR12
R12
400Ω
D4
R2
2kΩ
D8
R8
1.8kΩ
R13
90Ω
R14
90Ω
R22
3.9kΩ
6
8
9
7255490

B223

LINEAR MONOLITHIC INTEGRATED CIRCUITS

CHARACTERISTICS at $T_{amb} = 25°C$

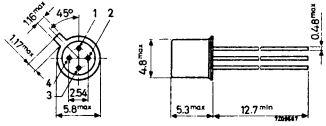
Hearing aid amplifiers

Type number	G_{tr}	P_o	f_c	P_{tot}	V_P	*Package*
OM200	80 dB	> 0.2 mW	20 kHz	max. 25 mW	max. 5 V	
TAA370	90 dB	1.5 mW	30 kHz	max. 120 mW	1.3 V	TO-89

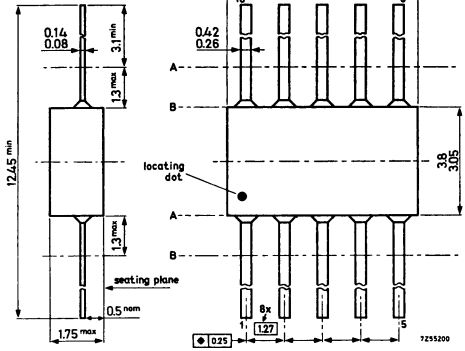
Instrumentation and control

TAA560 Level control amplifier and timer (TO-72)

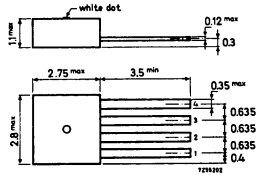
Supply voltage	2.0 to 2.5 V
Input threshold voltage	1.4 to 1.6 V.
Output current (off-state)	max. 0.1 μA
Output current (on-state)	max. 50 mA.

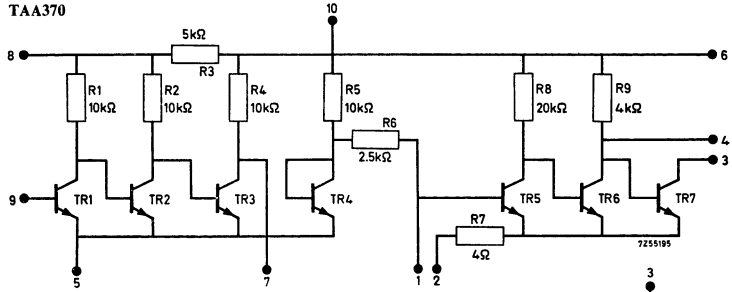


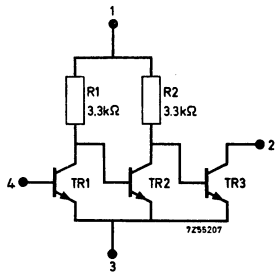
TO-72

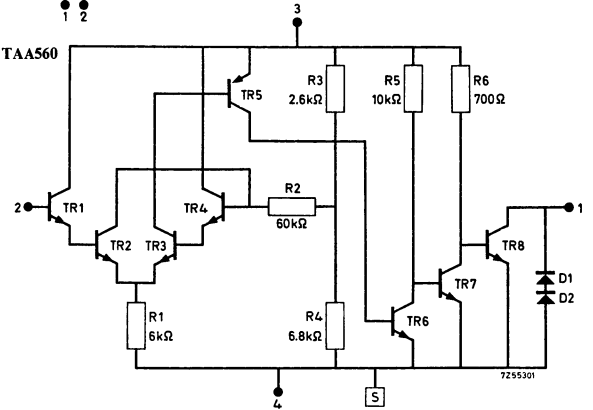


TO-89




TAA370
5kΩ
R3
10
8
6
R1
10kΩ
R2
10kΩ
R4
10kΩ
R5
10kΩ
R8
20kΩ
R9
4kΩ
R6
2.5kΩ
4
3
9
TR1
TR2
TR3
TR4
TR5
TR6
TR7
R7
4Ω
7Z55195
5
7
1
2


OM200
1
R1
3.3kΩ
R2
3.3kΩ
2
4
TR1
TR2
TR3
7Z55207
3

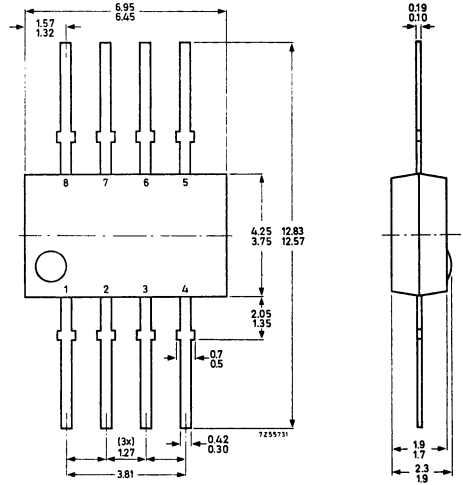

TAA560
3
TR5
R3
2.6kΩ
R5
10kΩ
R6
700Ω
2
TR1
TR4
R2
60kΩ
1
TR2
TR3
TR8
D1
D2
TR7
R1
6kΩ
R4
6.8kΩ
TR6
7Z55301
4
S

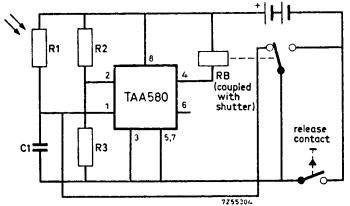
B225

Instrumentation and control

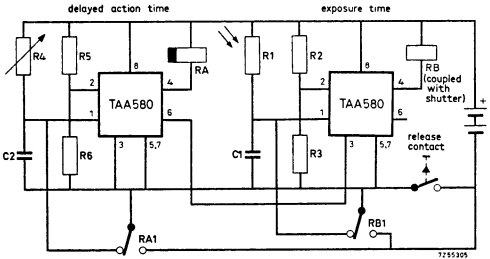
TAA580 level detector (plastic flat package)

Supply voltage	2 V
Threshold voltage	1.4 to 1.9 V
ON-state of TR9:	
Output current	70 mA
Output voltage	200 mV
OFF-state of TR9:	
Output current	200 μA





Camera shutter time control



Delayed action shutter

Notes:

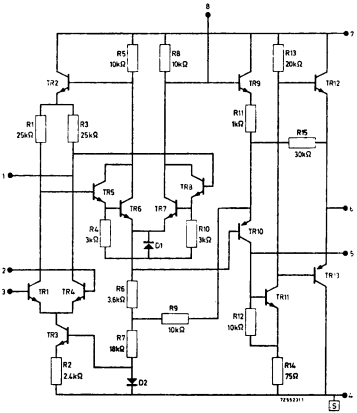
1. For shutter time range of 1 ms to 20 s; $C_1 \approx 270$ nF; $R_1 \leqslant 70$ MΩ.
2. Solenoid inductance $L_S \leqslant 180$ mH
   R_S values: 64 Ω to 114 Ω
   } DATA for RB and RA

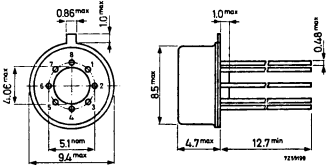
CHARACTERISTICS at $T_{amb} = 25°C$

Operational amplifiers

Type number	G_v	*CMRR*	V_i	V_{io}	I_{io}	V_{oM} (*typ.*)	V_P	V_N	*Package*
TAA521	45000	90 dB	8 to 10 V	< 7.5 mV	< 0.75 μA	13 V	15 V	15 V	TO-99
TAA522	45000	90 dB	8 to 10 V	< 5.0 mV	< 0,2 μA	14 V	15 V	15 V	TO-99
TBA221	100000	90 dB	> ±12 V	< 6 mV	< 0.2 μA	±10 V	15 V	15 V	TO-99
TBA222	200000	90 dB	> ±12 V	< 5 mV	< 0.2 μA	±10 V	15 V	15 V	TO-99

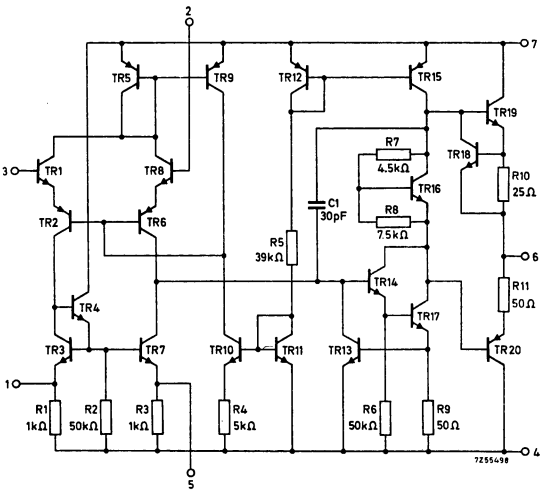
TAA521/TAA522





TO-99

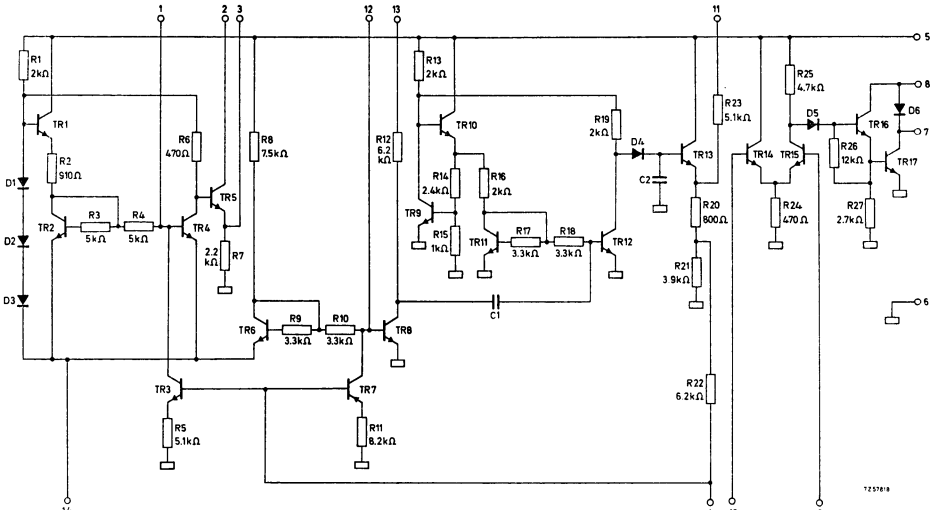
TBA221/TBA222



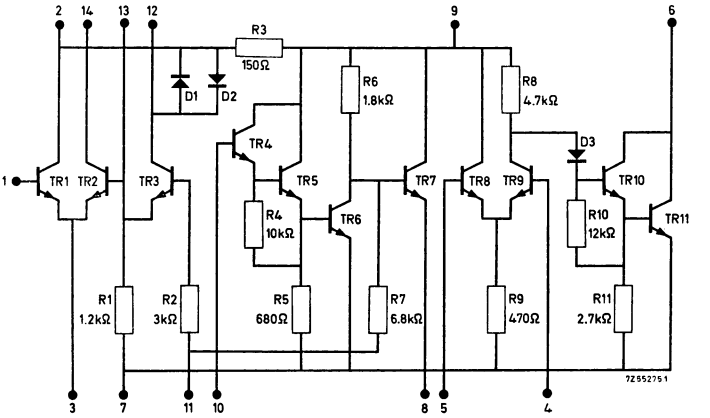
CHARACTERISTICS at $T_{amb} = 25°C$.

Radio circuits

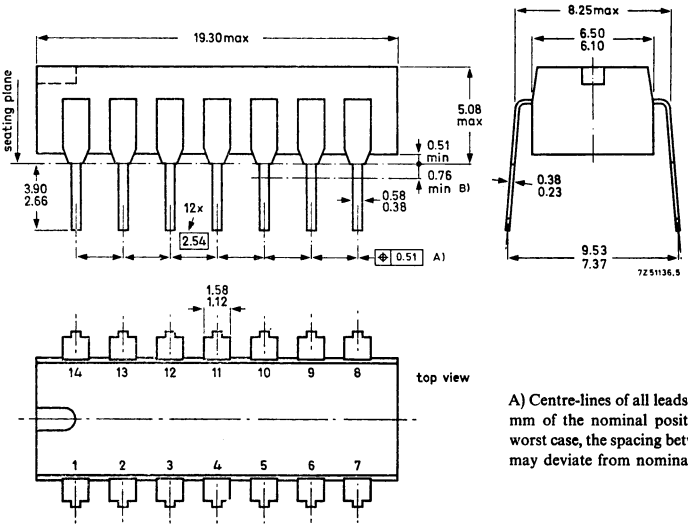
Type number	*Description*	*Supply voltage*	*Obtainable output power*	*Total quiescent current*	*Sensitivity*	*Package*
TAA840	R.F. amplifier, local oscillator, mixer, i.f. amplifier, detector a.g.c., for AM-radio, audio pre-amplifier	6 V	0.5 W	16.5 mA	2 μV	DIL 14p
TAD100	mixer, oscillator i.f. amplifier, a.g.c.-detector, audio pre-amplifier for AM-radio	6.0 V	0.7 W	15 mA	4 μV	DIL 14p
		9.0 V	1.5 W	23 mA	4 μV	DIL 14p


1
2
3
12
13
11
5
8
7
6
14
4
10
9
R1 2kΩ
R2 910Ω
R3 5kΩ
R4 5kΩ
R5 5.1kΩ
R6 470Ω
R7 2.2 kΩ
R8 7.5kΩ
R9 3.3kΩ
R10 3.3kΩ
R11 8.2kΩ
R12 6.2 kΩ
R13 2kΩ
R14 2.4kΩ
R15 1kΩ
R16 2kΩ
R17 3.3kΩ
R18 3.3kΩ
R19 2kΩ
R20 800Ω
R21 3.9kΩ
R22 6.2kΩ
R23 5.1kΩ
R24 470Ω
R25 4.7kΩ
R26 12kΩ
R27 2.7kΩ
C1
C2
D1
D2
D3
D4
D5
D6
TR1
TR2
TR3
TR4
TR5
TR6
TR7
TR8
TR9
TR10
TR11
TR12
TR13
TR14
TR15
TR16
TR17
TZ57818

TAD100


2
14
13
12
9
6
R3
150Ω
D1
D2
R6
1.8kΩ
R8
4.7kΩ
D3
TR4
1
TR1
TR2
TR3
TR5
TR7
TR8
TR9
TR10
R4
10kΩ
TR6
TR11
R10
12kΩ
R1
1.2kΩ
R2
3kΩ
R5
680Ω
R7
6.8kΩ
R9
470Ω
R11
2.7kΩ
7Z55275.1
3
7
11
10
8
5
4

14 pin dual in-line (DIL 14p)



A) Centre-lines of all leads are within ± 0.254 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by ± 0.51 mm.

CHARACTERISTICS at $T_{amb} = 25°C$

Television circuits

Type number	*Description*	V_P	G_c	*Input limiting voltage*	*Package*
TAA350	Wide band differential amplifier	6 V	80 dB	100 μV	TO-74
TAA450	R.F. amplifier ratio detector a.f. amplifier	7.5 V	69 dB	300 μV	TO-74
TAA570	Four stage limiter amplifier, f.m. detector	12 V	80 dB	100 μV	TO-74

TAA700 Television signal processing circuit

- Video pre-amplifier
- Gated a.g.c. detector for vision i.f. amplifier and tuner
- Noise gate for a.g.c. and sync. separator circuits
- Sync. separator
- Automatic horizontal synchronisation
- Vertical sync. pulse separator
- Blanking facility for video amplifier.

Video amplifier — gain 9.5 dB

A.G.C. *circuit* — available a.g.c. voltage
0 to 7 V (for tuner)
0 to 8 V (for i.f.)

Vert. synchronisation circuit — Vertical output pulses: min 10 V

Package — QUIL 16p

Total power dissipation 600 mW

Supply voltage 12 V

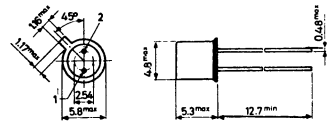
TAA550 Voltage stabilizer (TO-18)

Supply current typ. 5 mA

Stabilized voltage 30 to 35 V

Differential internal resistance: typ. 12Ω.

Temp. stabilisation: { typ. 0.13 mV/°C
{ −3.1 to +1.55 mV/°C



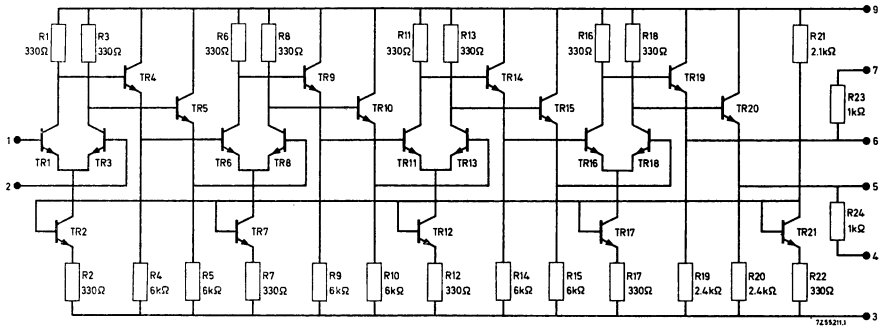
TO-18 (2-pins)

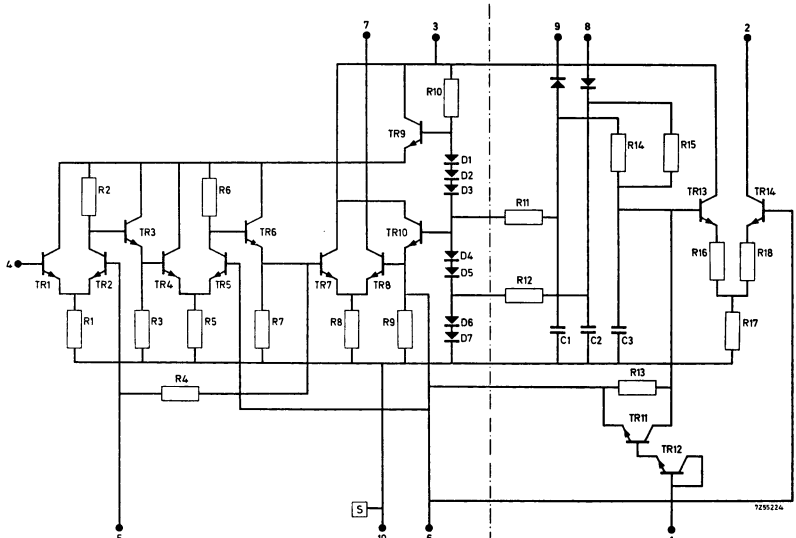
TAA630 Synchronous demodulator for colour difference drive

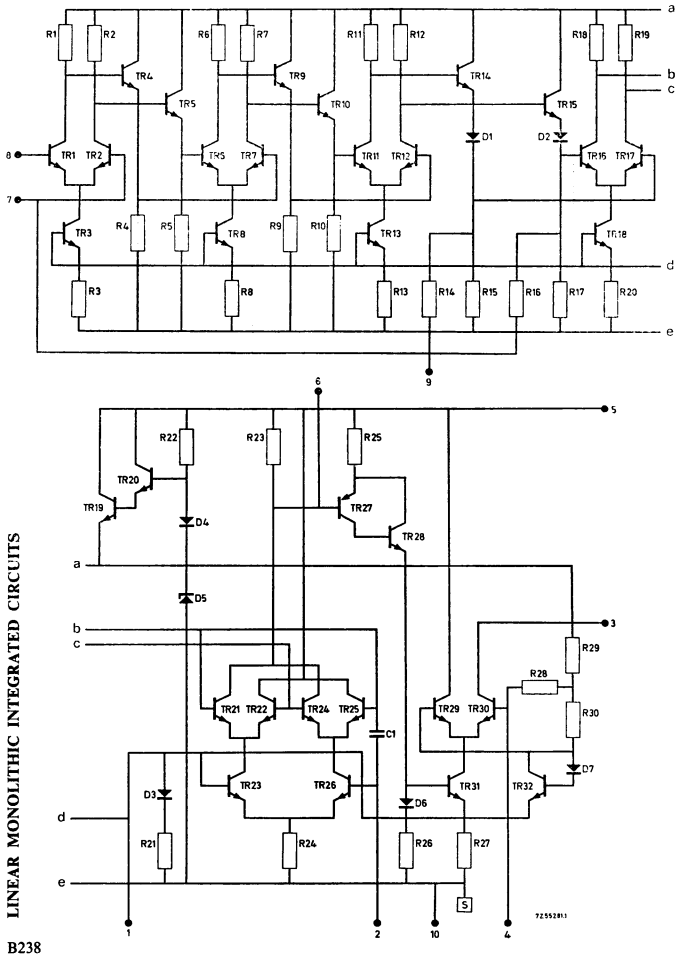
Supply voltage	12 V	Package: 16 lead dual in-line
Gain of $R-Y$ demodulation	7	
Gain of $B-Y$ demodulator	12.5	
Input impedance of $R-Y$ and $B-Y$ channel	1 kΩ	
Output impedance of $R-Y$, $B-Y$ and $G-Y$ channel	100 Ω	
Operating ambient temperature	-20 to $+80°C$	

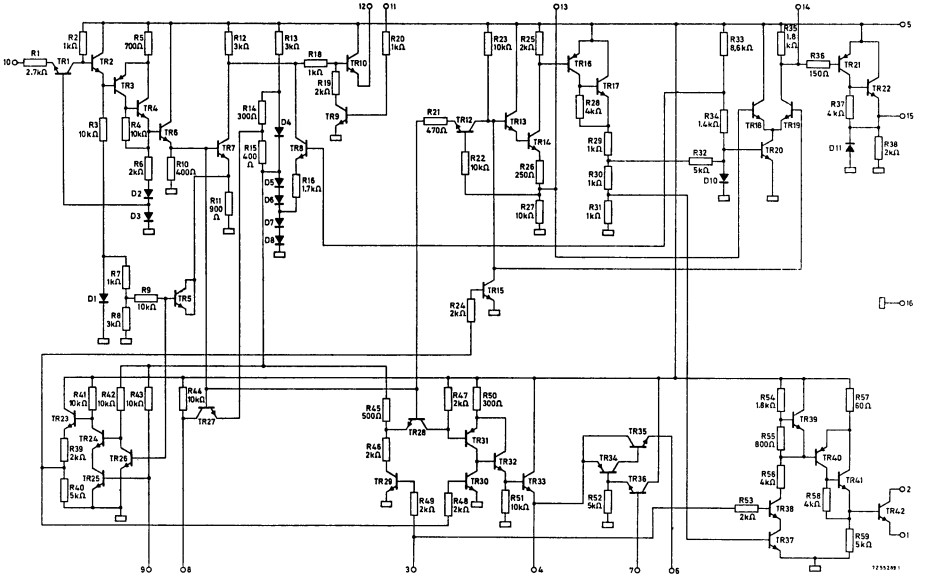
LINEAR MONOLITHIC INTEGRATED CIRCUITS

TAA350



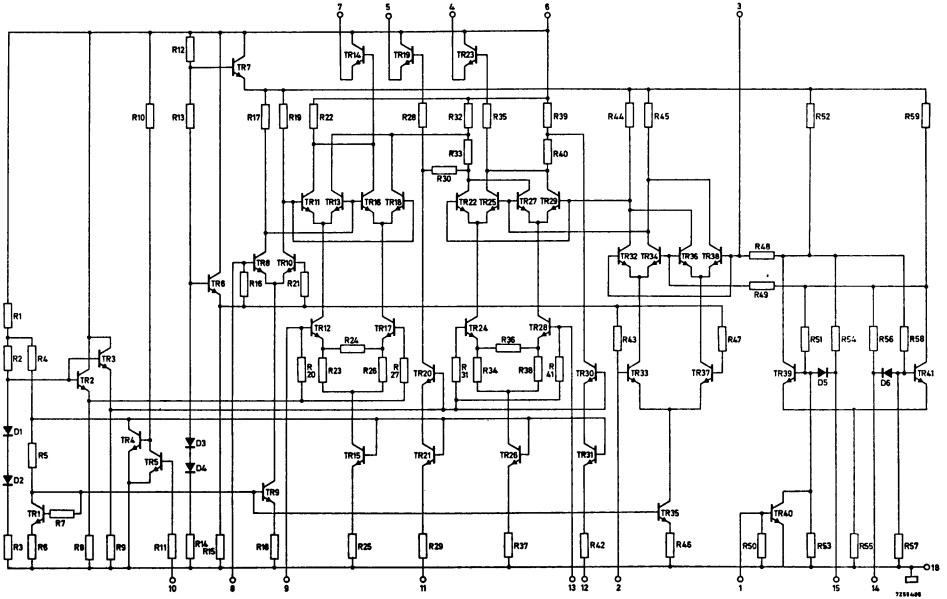

7
3
9
8
2
R10
TR9
D1
D2
D3
R14
R15
R2
R6
R11
TR13
TR14
TR3
TR6
TR10
D4
D5
R16
R18
4
TR1
TR2
TR4
TR5
TR7
TR8
R12
R1
R3
R5
R7
R8
R9
D6
D7
C1
C2
C3
R17
R4
R13
TR11
TR12
S
7295224
5
10
6
1


R1
R2
R6
R7
R11
R12
R18
R19
TR4
TR5
TR9
TR10
TR14
TR15
a
b
c
D1
D2
8
7
TR1
TR2
TR6
TR7
TR11
TR12
TR16
TR17
TR3
R4
R5
TR8
R9
R10
TR13
TR18
d
R3
R8
R13
R14
R15
R16
R17
R20
e
9
6
5
R22
R23
R25
TR20
TR19
TR27
D4
TR28
a
D5
b
c
3
R29
R28
TR21
TR22
TR24
TR25
C1
TR29
TR30
R30
D7
TR23
TR26
TR31
TR32
D3
D6
d
R21
R24
R26
R27
e
S
1
2
10
4
72552811

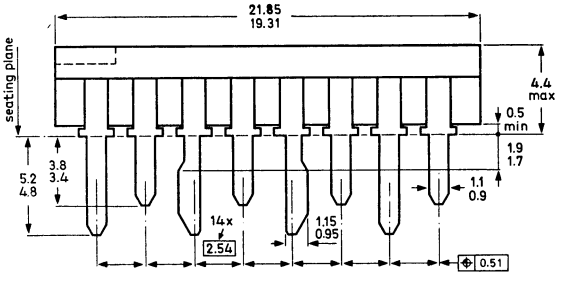

R1 2.7kΩ
R2 1kΩ
R3 10kΩ
R4 10kΩ
R5 700Ω
R6 2kΩ
R7 1kΩ
R8 3kΩ
R9 10kΩ
R10 400Ω
R11 900Ω
R12 3kΩ
R13 3kΩ
R14 300Ω
R15 400Ω
R16 1.7kΩ
R18 1kΩ
R19 2kΩ
R20 1kΩ
R21 470Ω
R22 10kΩ
R23 10kΩ
R24 2kΩ
R25 2kΩ
R26 250Ω
R27 10kΩ
R28 4kΩ
R29 1kΩ
R30 1kΩ
R31 1kΩ
R32 5kΩ
R33 8.6kΩ
R34 1.4kΩ
R35 1.8 kΩ
R36 150Ω
R37 4kΩ
R38 2kΩ
R41 10kΩ
R42 10kΩ
R43 10kΩ
R44 10kΩ
R45 500Ω
R46 2kΩ
R47 2kΩ
R48 2kΩ
R49 2kΩ
R50 300Ω
R51 10kΩ
R52 5kΩ
R53 2kΩ
R54 1.8kΩ
R55 800Ω
R56 4kΩ
R57 60Ω
R58 4kΩ
R59 5kΩ
TR1
TR2
TR3
TR4
TR5
TR6
TR7
TR8
TR9
TR10
TR11
TR12
TR13
TR14
TR15
TR16
TR17
TR18
TR19
TR20
TR21
TR22
TR23
TR24
TR25
TR26
TR27
TR28
TR30
TR31
TR32
TR33
TR34
TR35
TR36
TR37
TR38
TR39
TR40
TR41
TR42
D1
D2
D3
D4
D5
D6
D7
D8
D10
D11
10
11
12
13
14
15
16
90
80
30
40
70
60
1
2
5

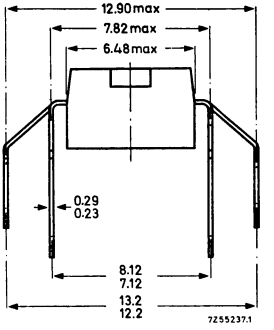
LINEAR MONOLITHIC INTEGRATED CIRCUITS

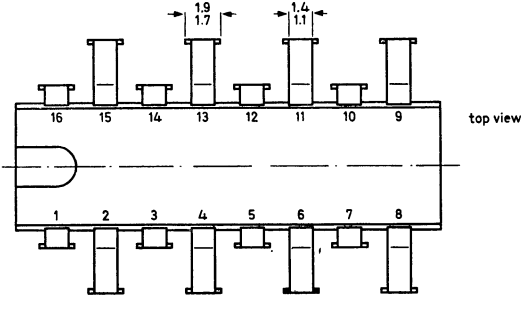
TAA630



Quadruple in-line (QUIL 16p)







LINEAR MONOLITHIC INTEGRATED CIRCUITS

CHARACTERISTICS at $T_{amb} = 25°C$.

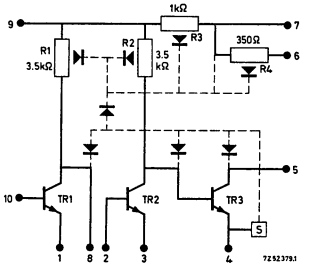
Various applications

TAA293 General purpose amplifier (TO-74)

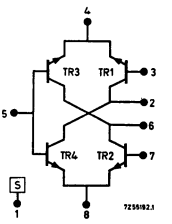
Supply voltage	6.0 V
Transducer gain	80 dB
Noise figure	6 dB
Frequency reponse	600 kHz

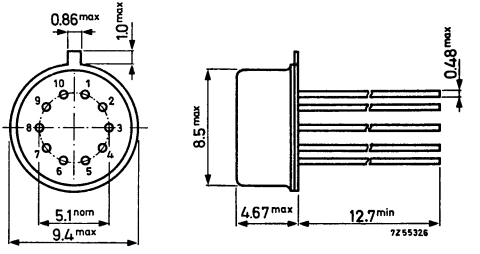
TAB101 Ring (de)modulator (TO-74)
Collector cut-off current max. 100 nA
Base-emitter voltage differences max. 5 mV
Common-base current gain differences max. 0.008

TAA293



TAB101





TO-74 (reduced height)

TAA640 Limiter amplifier (with f.m. detector and a.f. pre-amplifier)

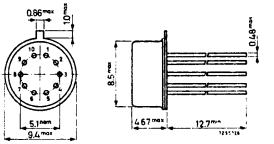
Supply voltage	22 V
Total current drain	26.7 mA
Input limiting voltage	100 μV
A.M. rejection	44 dB
A.F. output voltage	1.6 V
Total distortion ($\Delta f = \pm 50$ kHz)	5%
Total distortion ($\Delta f = \pm 15$ kHz)	1.6%

Package: TO-116 (14 lead quadruple in-line)

TAA960 Triple amplifier for active filters

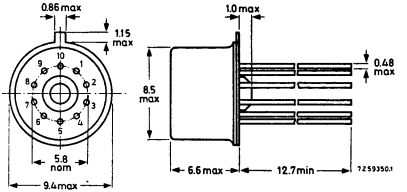
Supply voltage	6 V
Supply current	1.9 mA
Transfer admittance	9 mΩ^{-1}
Voltage gain (each ampl.)	39 dB
Input resistance (pin 1, 7, 8)	25 kΩ
Output resistance (pin 2, 5, 6)	9 kΩ
(pin 4)	500 Ω
Q factor (in RC filter)	45

Package: TO-74 (reduced height)



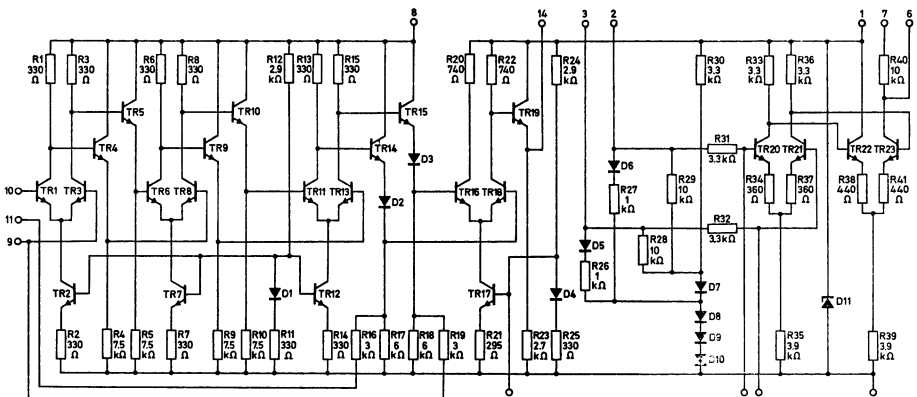
TBA281 Voltage regulator

Line regulation	0.1% V_o
Load regulation	0.03% V_o
Stand-by current drain	2.3 mA
Input voltage range	9.5 to 40 V
Output voltage range	2.0 to 37 V
Input-output voltage difference	3.0 to 38 V

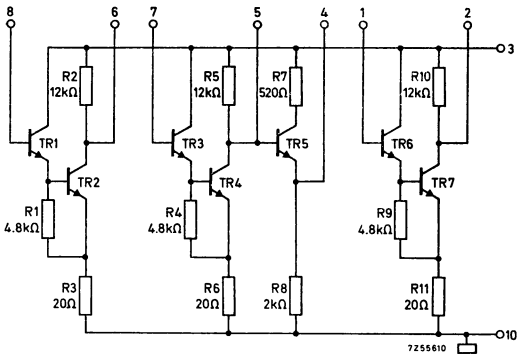


LINEAR MONOLITHIC INTEGRATED CIRCUITS

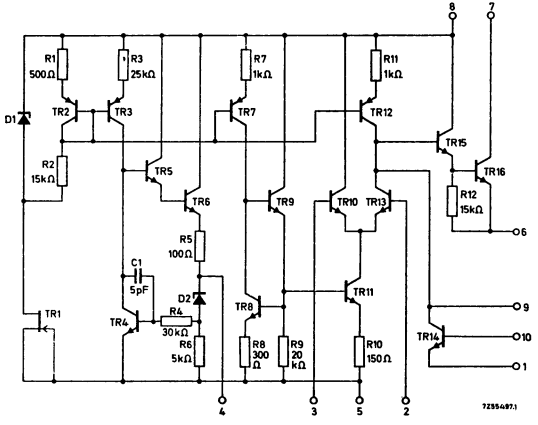
TAA640



TAA960



TBA281



Pinning

1. Current sense
2. Inverting input
3. Non-inverting input
4. Reference voltage (V_{ref})
5. Negative supply voltage ($-V_N$)
6. Output voltage (V_o)
7. Collector voltage (V_C)
8. Positive supply voltage (V_P)
9. Frequency compensation
10. Current limit

REPLACEMENT GUIDE
SEMICONDUCTORS

REPLACEMENT GUIDE TRANSISTORS

Type to be replaced	Replacement type
AC107	(AC125R)
AC116	(AC125)
AC117	AC128K
AC121	AC128
AC122	(AC125)
AC124	(AC128K)
AC127	AC127
AC128	AC128
AC130	(AC127)
AC131	(AC128)
AC131/30	(AC128)
AC132	AC132
AC150/30	(AC125R)
AC151	(AC125)
AC152	AC128
AC153	AC128
AC153K	AC128K
AC160K	(AC125R)
AC161	AC125R
AC162	AC128
AC163	AC128
AC170	(AC125)
AC171	(AC126)
AC172	AC127
AC173	AC132
AC175	(AC187K)
AC176	(AC187)
AC176K	(AC187K)
AC178	AC128K
AC179	(AC187K)
AC180	AC128
AC180K	AC128K
AC181	(AC127)
AC181K	(AC187K)
AC184	AC128
AC185	AC127
AC186	(AC187K)
AC187	AC187
AC187	AC187K
AC188	AC188
AC188K	AC188K
AC193K	(AC188K)
AC194K	AC187K
ACY16	(AC128K)
ACY23	AC125
ACY32	AC125R
ACY33	AC128
ACY38	(AC125R)
AD130	AD149
AD131	(AD149)
AD132	(ASZ15)
AD133	(ADZ11)
AD136	(ASZ18)
AD138	ASZ16
AD138/50	(ASZ15)
AD139	AD139
AD142	(ASZ15)
AD143	(ASZ16)
AD145	(ASZ16)
AD148	(AD139)
AD149	AD149
AD150	AD149
AD152	(AD162)
AD153	AD149
AD155	AD162
AD159	(ASZ17)
AD160	(ASZ16)
AD161	AD161
AD162	AD162
AD163	(ASZ15)
AD164	AD162
AD165	AD161
AD166	(BD132)
AD169	(AD162)
AD262	AD139
AD263	(BD132)
ADY26	ADY26
ADY27	AD149
ADY28	ASZ15
ADZ11	ADZ11
ADZ12	ADZ12
AF102	(AF106)
AF106	AF106
AF109R	AF109R
AF114	(AF124)
AF115	(AF125)
AF116	(AF126)
AF117	(AF127)
AF118	AF118
AF121	AF121
AF124	AF124
AF125	AF125
AF126	AF126
AF127	AF127
AF134	(AF124)
AF135	(AF125)
AF136	(AF125)
AF137	(AF126)
AF138	(AF126)
AF139	AF139
AF178	(AF106)
AF180	(AF109R)
AF181	(AF121)
AF185	(AF121)
AF193	AF121

Type to be replaced	Replacement type
AF200	AF121
AF201	AF121
AF202	AF121
AF202S	AF121S
AF239	AF239
AF239S	AF239S
AF240	AF239S
AF251	(AF239S)
AF252	(AF239)
AF253	(AF139)
AF267	AF267
AF279	AF279
AF280	AF280
AFY11	(AFY19)
AFY12	AF106
AFY13	(AF124)
AFY14	(ASY27)
AFY15	(AF126)
AFY16	AFY16
AFY18	(AFY19)
AFY29	(AF126)
AFY37	(AFY40)
AFY39	(AFY40)
AFY40	(AF239S)
AFY41	(AF239)
AFY42	(AFY40)
AFZ12	AF106
ASY14	(ASY77)
ASY24	(ASY80)
ASY24B	(ASY76)
ASY26	ASY26
ASY27	ASY27
ASY28	ASY28
ASY29	ASY29
ASY30	(ASY80)
ASY31	(ASY26)
ASY32	(ASY27)
ASY48	(2N2906A)
ASY70	(ASY80)
ASY73	ASY73
ASY74	ASY74
ASY75	ASY75
ASY76	ASY76
ASY77	ASY77
ASY80	ASY80
ASY81	ASY77
ASZ11	(ASY26)
ASZ12	(ASY27)
ASZ15	ASZ15
ASZ16	ASZ16
ASZ17	ASZ17
ASZ18	ASZ18
ASZ20	(ASY80)
(ASZ21	(BC178VI)
ASZ23	(BCY70)
ASZ30	(ASY26)
AT605	(BD160)
AU103	(299BD)
AU104	(299BD)
AU105	(ASZ15)
AU106	(299BD)
AU108	(ASZ15)
AU110	(2N3442)
AU111	(299BD)
AU112	(299BD)
AU113	(299BD)
AUY10	(2N4033)
AUY18	(BD132)
AUY19	ASZ15
AUY20	(ASZ15)
AUY21	ASZ15
AUY21A	(ASZ15)
AUY22	ASZ15
AUY22A	(ASZ15)
AUY28	(ASZ15)
AUY29	(ADZ11)
AUY30	ASZ15
AUY31	ASZ16
AUY32	ASZ15
AUY33	ASZ16
AUY34	(ASZ15)
AUY35	(ASZ16)
AUY38	(ASZ15)
BC26J	BC179
BC100	(BD115)
BC107A	BC107A
BC107B	BC107B
BC108A	BC108A
BC108B	BC108B
BC108C	BC108C
BC109B	BC109B
BC109C	BC109C
BC110	(BF177)
BC112	BC146
BC113	BC238B
BC114	BC239B
BC115	BC237A
BC116	(BC307VI)
BC117	BF178
BC118	BC237A

REPLACEMENT GUIDE TRANSISTORS

Type to be replaced	Replacement type
BC119	2N2218
BC120	2N2218
BC121BL	(BC146GN)
BC121YW	(BC146YW)
BC121GR	(BC146YW)
BC121WH	(BC146RD)
BC122BL	(BC146GN)
BC122YW	(BC146YW)
BC122GR	(BC146GN)
BC122WH	(BC146RD)
BC125	(BC337)
BC126	(BC338)
BC127	BC146RD
BC128	BC146GN
BC129	(BC107)
BC130	(BC108)
BC131	(BC109)
BC132	BC238A
BC134	(BC237B)
BC135	(BC237A)
BC136	(BC237A)
BC137	(BC327)
BC138	2N2219
BC139	2N2904
BC140-6	BC140-6
BC140-10	BC140-10
BC140-16	BC140-16
BC141-6	BC141-6
BC141-10	BC141-10
BC141-16	BC141-16
BC142	BC141-6
BC143	BC161-6
BC144	2N2218A
BC145	BF178
BC146	BC146

Type to be replaced	Replacement type
BC147	BC147
BC148	BC148
BC149	BC149
BC153	BC307A
BC154	BC307A
BC155	(BC146)
BC156	BC146
BV157	BC157
BC158	BC158
BC159	BC159
BC160-6	BC160-6
BC160-10	BC160-10
BC160-16	BC160-16
BC161-6	BC161-6
BC161-10	BC161-10
BC161-16	BC161-16
BC167	BC237
BC168	BC238
BC169	BC239
BC170A	BC238A
BC170B	BC238A
BC170C	BC238
BC171A	BC237A
BC171B	BC237B
BC172A	BC238A
BC172B	BC238B
BC172C	BC238C
BC173B	BC239B
BC173C	BC239C
BC174A	BC174A
BC174B	BC174B
BC177	BC177
BC178	BC178
BC179	BC179
BC181	(BC308VI)

Type to be replaced	Replacement type
BC182	BC174
BC183	(BC237A)
BC184	(BC239B)
BC185	2N2219
BC186	BC107A
BC187	BC177VI
BC190A	(BC107A)
BC190B	(BC107A)
BC192	2N2907
BC194	(BC246RD)
BC196/4	(BC200RD)
BC196A	(BC200GN)
BC196B	(BC200YW)
BC197	(BC237B)
BC198	(BC146YW)
BC199	(BC146GN)
BC200	BC200
BC201	(BC200)
BC202	(BC200YW)
BC203	(BC200YW)
BC204	BC307
BC213	(BC307VI)
BC214	(BC307A)
BC215A	BC327
BC215B	BC327
BC216	(BC107A)
BC220	(BC237A)
BC221	BC328
BC222	BC338
BC223	BC337
BC224	BC308B
BC225	(BC307A)
BC231A	BC327
BC231B	BC327
BC232A	BC337

Type to be replaced	Replacement type
BC232B	BC337
BC237	BC237
BC238	BC238
BC239	BC239
BC250A	BC308VI
BC250B	BC308VI
BC250C	BC308B
BC251A	BC307A
BC251B	(BC208B)
BC251C	(BC308B)
BC252A	BC308A
BC252B	BC308B
BC252C	(BC308B)
BC253A	BC309A
BC253B	BC309B
BC253C	(BC309B)
BC254	(BC307A)
BC255	(BC337)
BC256A	(BC307A)
BC256B	(BC307A)
BC257	(BC307)
BC258	(BC307)
BC259	(BC309)
BC260A	BC178VI
BC260B	BC178VI
BC260C	BC178B
BC261A	BC177A
BC261B	BCY79IX
BC262A	BC178A
BC262B	BC178B
BC263A	BC179A
BC263B	BC179B
BC266A	(BC307A)
BC266B	(BC307A)
BC267A	(2N2222A)
BC267B	(BC337)
BC268	(BC338)
BC269	(BC109)
BC270	(BC338)
BC271	(BC338)
BC272	(BC337)
BC283	(2N2906)
BC285	(BF336)
BC286	BC141-16
BC287	BC161-10
BC288	(BFX34)
BC289	BC107
BC290A	BC107B
BC291	BCY79VIII)
BC292	BCY79X
BC293	(BFX34)
BC297	(BC327)
BC297P	(BC307A)
BC298	(BC328)
BC300	2N3019
BC301	(BC141-6)
BC302	(BC140-6)
BC303	2N4036
BC304	(BC160-6)
BC307	BC307
BC308	BC308
BC309	BC309
BC313	BC160-6
BC314	(BD139)
BC315	(BC415A)
BC320A	(BC327)
BC320B	(BC327)
BC327	BC327
BC328	BC328
BC333	(BC239B)
BC334	(BC309A)
BC335	(BC239B)
BC336	(BC309A)
BC337	BC337
BC338	BC338
BC340-6	2N2218A
BC340-10	2N2219A
BC340-16	2N2219A
BC341-6	BC141-6
BC341-10	BC141-10
BC342	(BC141-6)
BC343	(BC161-6)
BC344	(BD139)
BC345	(BD140)
BC347	BC237A/B
BC348	BC237A/B
BC349	BC308VI/A
BC350	BC307VI/A
BC351	BC307VI/A
BC352	BC308VI/A
BC354	(BC238A/B)
BC355	(BC308VI/B)
BC357	BC308
BC360-6	2N2904
BC360-10	2N2905
BC360-16	2N2905
BC361-6	2N2904A
BC361-10	2N2905A
BC370	(BC328)
BC377	(BC337)
BC378	(BC338)
BC381	BC328
BC382	BC414A/B
BC383	BC413B/C
BC384	BC413B

REPLACEMENT GUIDE TRANSISTORS

Type to be replaced	Replacement type
BC385	BC237
BC386	BC238
BC387	(BC337)
BC388	(BC327)
BC397	(BC161-6)
BC398	(BC141-6)
BC399A	(BC146YW)
BC399B	(BC146GN)
BC407	BC237
BC408	BC238
BC409	BC239
BC413	BC413
BC414	BC414
BC415	BC415
BC416	BC416
BCW34	(2N2222A)
BCW35	(2N2907A)
BCW36	(2N2222A)
BCW37	(2N2907A)
BCW46	BCW46
BCW47	BCW47
BCW48	BCW48
BCW49	BCW49
BCW56	BCW56
BCW57	BCW57
BCW58	BCW58
BCW59	BCW59
BCW69	BCW69
BCW70	BCW70
BCW71	BCW71
BCW72	BCW72
BCW85	(2N2907A)
BCW86	(BC177A)
BCY30	(BCW56A)
BCY31	(BCW56A)
BCY32	(BCW56A)
BCY33	(BCY78VII)
BCY34	(BCY78VII)
BCY38	(2N2904)
BCY39	(2N2904A)
BCY40	(2N2904)
BCY54	(2N2904A)
BCY55	BCY55
BCY56	BCY56
BCY57	BCY57
BCY58A	BCY58VII
BCY58B	BCY58VIII
BCY58C	BCY58IX
BCY58D	BCY58X
BCY59A	BCY59VII
BCY59B	BCY59VIII
BCY59C	BCY59IX
BCY59D	BCY59X
BCY65	(BC174)
BCY66	BCY59VIII
BCY67	(BCY71)
BCY70	BCY70
BCY71	BCY71
BCY72	BCY72
BCY78	BCY78
BCY79	BCY79
BCY85A	(BCW46A)
BCY85B	(BCW46B)
BCY86A	(BC107B)
BCY86B	(BCY59X)
BCY87	BCY87
BCY88	BCY88
BCY89	BCY89
BCZ13	(BC200RD)
BCZ14	(BC200RD)
BD106A	BD124
BD107A	(BD124)
BD109	(BD124)
BD111	(BDY92)
BD113	(BD145)
BD115	BD115
BD116	(BD145)
BD124	BD124
BD130	2N3055
BD131	BD131
BD132	BD132
BD135	BD135
BD136	BD136
BD137	BD137
BD138	BD138
BD139	BD139
BD140	BD140
BD141	2N3442
BD142	(2N3055)
BD144	BD144
BD145	BD145
BD160	BD160
BD162	(BD131)
BD163	(BD131)
BD165	(BD131)
BD166	(BD132)
BD167	(BFX34)
BD168	(BFS92)
BD169	(BSW66)
BD170	(2N4033)
BD171	(BSW67)
BD172	(BSW67)
BD173	BD137)
BD175	(BD131)
BD176	(BD132)

Type to be replaced	Replacement type
BD177	(BDY61)
BD179	(BU126)
BD181	BD181
BD182	BD182
BD183	BD183
BD185	(BD131)
BD186	(BD132
BD187	(BD131)
BD188	(BD132)
BD189	(BDY61)
BDX10	2N3055
BDX11	2N3442
BDX12	2N4347
BDX13	(BDY38)
BDY10	(BDY38)
BDY11	(2N3055)
BDY12	(BD124)
BDY13	(BD124)
BDY15A	BD124
BDY16A	(BD124)
BDY17	2N3055
BDY18	(BD183)
BDY19	2N3442
BDY20	2N3055
BDY23	(BDY92)
BDY24	(BDY91)
BDY25	(2N3442)
BDY26	(BD160)
BDY27	(BU126)
BDY28	(BU126)
BDY34	BD124
BDY38	BDY38
BDY39	(2N3055)
BDY49	(BDY19)
BDY53	(BDY92)

Type to be replaced	Replacement type
BDY55	2N3055
BDY60	BDY60
BDY61	BDY61
BDY62	BDY62
BDY71	(BDY61)
BDY72	(2N4347)
BDY73	(2N3055)
BDY74	(2N3442)
BDY75	(2N3771)
BDY76	(2N3772)
BDY77	(2N3442)
BDY78	(2N3054)
BDY79	(2N4347
BDY80A	(BD131)
BDY81A	(BD131)
BDY82A	(BD132)
BDY83A	(BD132)
BDY90	BDY90
BDY91	BDY91
BDY92	BDY92
BDY93	BDY93
BDY94	BDY94
BDY95	BDY95
BDY96	BDY96
BDY97	BDY97
BDY98	BDY98
BF109	(BF178)
BF110	(BF178)
BF111	(BD115)
BF114	(BF178)
BF115	BF115
BF117	BF178
BF118	(BF338)
BF119	BF337
BF120	(BF179)

Type to be replaced	Replacement type
BF121	(BF196)
BF123	(BF197)
BF125	(BF197)
BF127	BF196
BF140	BF178
BF140D	BF178
BF152	BF183
BF153	(BF255)
BF154	BF196
BF155	(BF180)
BF156	BF178
BF157	BF179
BF158	BF173
BF159	BF173
BF160	(BF255)
BF161	(BF181)
BF162	(BF200)
BF163	BF196
BF164	BF167
BF165	BF185
BF166	BF200
BF167	BF167
BF169	(BF115)
BF169R	(BF115)
BF173	BF173
BF174	BF178
BF175	BF167
BF176	BF173
BF177	BF177
BF178	BF178
BF179C	BF179C
BF180	BF180
BF181	BF181
BF182	BF182
BF183	BF183

REPLACEMENT GUIDE TRANSISTORS

Type to be replaced	Replacement type
BF184	BF184
BF185	BF185
BF186	BF178
BF189	BF115
BF194	BF194
BF195	BF195
BF196	BF196
BF197	BF197
BF198	(BF196)
BF199	(BF197)
BF200	BF200
BF223	(BF197)
BF224	(BF173)
BF225	(BF196)
BF228	(BSW69)
BF229	(BF254)
BF230	(BF195)
BF232	(BF173)
BF234	(BF254)
BF235	(BF255)
BF237	(BF115)
BF238	(BF115)
BF240	BF240
BF241	BF241
BF251	BF167
BF254	BF254
BF255	BF255
BF257	BD115
BF258	BF338
BF259	(BF338)
BF260	(BF200)
BF268	BFY90
BF270	(BF167)
BF271	(BF173)
BF287	(BF167)
BF288	(BF167)
BF294	(BD115)
BF305	(BF337)
BF310	(BF181)
BF311	BF311
BF314	(BF200)
BF324	BF324
BF334	BF334
BF335	BF335
BF336	BF336
BF337	BF337
BF338	BF338
BF341	(AF121)
BF342	(BF450)
BF343	(BF451)
BF357	(BFW92)
BF384	(BF180)
BF385	(BF180)
BF397	(2N3963)
BF450	BF450
BF451	BF451
BF456	(BD115)
BF457	(BD115)
BF458	(BD115)
BF459	(BF338)
BFR22	2N2102
BFR23	2N4036
BFR24	2N4037
BFR25	(BSV68)
BFR57	(BF336)
BFR58	(BF337)
BFR59	(BF338)
BFS17	BFS17
BFS18	BFS18
BFS19	BFS19
BFS20	BFS20
BFS22	BFS22
BFS23	BFS23
BFS47	BSX21
BFS48	2N4031
BFS52	(2N2904)
BFS53	(2N2905)
BFS89	(BD115)
BFS92	BFS92
BFS93	BFS93
BFS94	BFS94
BFS95	BFS95
BFW16A	BFW16A
BFW17A	BFW17A
BFW30	BFW30
BFW46	2N3924
BFW47	2N3553
BFW60	(BC147A)
BFW92	BFW92
BFX33	(2N2218)
BFX34	BFX34
BFX37	(2N2907A)
BFX38	2N4032
BFX39	2N4030
BFX40	(2N4031)
BFX41	2N4031
BFX45	BCW49
BFX47	BFX47
BFX48	(2N2905)
BFX53	(BFY90)
BFX55	(BFS23)
BFX59	BFX89
BFX60	BF173
BFX62	BF180
BFX89	BFX89

Type to be replaced	Replacement type
BFY10	(2N929)
BFY11	(2N929)
BFY12	(2N2219A)
BFY17	(2N2218)
BFY19	BC108A
BFY20	(2N2218)
BFY22	BC146RD
BFY23	BC146RD
BFY23A	BC146GN
BFY24	BC146RD
BFY27	(2N2222A)
BFY29	(BC146RD)
BFY30	(BC146RD)
BFY33	(BSX95)
BFY34	BSX95
BFY37	BC108A
BFY39/1	(BC107A)
BFY39/2	(BC107A)
BFY39/3	(BC107B)
BFY40	2N2218
BFY41	(2N2218A)
BFY43	(BSW68)
BFY45	(BSW66)
BFY46	BSX96
BFY50	BFY50
BFY51	BFY51
BFY52	BFY52
BFY55	2N2297
BFY56	BSX61
BFY56A	BSW65
BFY64	(2N2905)
BFY65	BF177
BFY66	BF180
BFY67A	BFY67A
BFY67C	BFY67C
BFY68A	BFY68A
BFY69	(BC146)
BFY69A	(BC146)
BFY72	2N2219
BFY75	(2N2222A)
BFY77	BCY59IX
BFY80	BF177
BFY85	BCY87
BFY86	BCY89
BFY87	BC146
BFY87A	BC146
BFY88	(BFX89)
BFY90	BFY90
BFY91	(BCY59VII)
BFY92	(BCY59VII)
BFY99	2N3553
BLY14	(2N3553)
BLY15A	(2N2632)
BLY17	BLY17
BLY20	(2N3375)
BLY21	(2N3632)
BLY22	(2N3632)
BLY37	BLY37
BLY38	BLY38
BLY53	BLY53
BLY57	2N3926
BLY58	2N3927
BLY59	2N3375
BLY60	2N3927
BLY76	BLY76
BLY87	BLY87
BLY88	BLY88
BLY89	BLY89
BLY91	BLY91
BLY92	BLY92
BLY93	BLY93
BSS10	BSX20
BSS11	2N2369A
BSS12	BSX20
BSS13	2N3053
BSS14	BFX34
BSS15	BSV94
BSS16	BSV93
BSS17	(2N4036)
BSS18	(2N4036)
BSS19	(BSW69)
BSS20	(BSW69
BSV15	BSV15
BSV16	BSV16
BSV51	(BSX21)
BSV52	BSV52
BSV64	BSV64
BSV68	BSV68
BSV86	BSV86
BSV87	BSV87
BSV88	BSV88
BSV93	BSV93
BSV94	BSV94
BSW10	2N2218A
BSW11	(BSW59)
BSW12	BSX69
BSW13	BC146)
BSW19	(BCY78VII)
BSW20	(BC307)
BSW21	BCY72
BSW21A	BCY71
BSW22	(BC178B)
BSW22A	(BCY79VIII)
BSW25	(BCY72)
BSW26	(BSX59)

REPLACEMENT GUIDE TRANSISTORS

Type to be replaced	Replacement type
BSW27	(BSX59)
BSW28	BSX59
BSW29	BSX60
BSW32	(BSX21)
BSW33	BCW33
BSW34	BCW47
BSW35	BCW46
BSW41	BSW41
BSW42	(BC238A)
BSW42A	(BC237A)
BSW43	(BC238B)
BSW43A	(BC237B)
BSW44	(BC308VI/A)
BSW45	(BC308B)
BSW45A	(BC327)
BSW51	2N2218
BSW52	2N2219
BSW53	2N2218A
BSW54	2N2219A
BSW58	BSW58
BSW59	BSW59
BSW61	2N2221
BSW62	2N2222
BSW63	2N2221A
BSW64	2N2222A
BSW65	BSW65
BSW66	BSW66
BSW67	BSW67
BSW68	BSW68
BSW69	BSW69
BSW72	2N2906
BSW73	2N2907
BSW74	2N2906
BSW75	2N2907
BSW82	2N2221
BSW83	2N2222
BSW84	2N2221A
BSW85	2N2222A
BSW88	(BSW33)
BSW89	(BSW33)
BSX12	BSX12
BSX12A	BSX12A
BSX19	2N2368
BSX20	2N2369
BSX21	BSX21
BSX22	(BFY50)
BSX23	BFX34
BSX24	(BSW41)
BSX25	(BSW41)
BSX27	BSX20
BSX28	BSX20
BSX29	2N2894
BSX32	2N2218
BSX33	2N2218A
BSX35	(BSX20)
BSX36	(BSW41)
BSX38	(BCY58VII)
BSX39	BSX20
BSX40	2N2904
BSX41	2N2905
BSX45	(2N2218A)
BSX46	BSV64
BSX48	(2N2221)
BSX49	(2N2222A)
BSX51	BCY58VII
BSX51A	BC107A
BSX52	BCY58VIII
BSX52A	BC1078
BSX53	(BCY58VIII)
BSX54	(BC107A)
BSX59	BSX59
BSX60	BSX60
BSX61	BSX61
BSX62	(BSW65)
BSX63	BSW65
BSX66	BC108A
BSX67	BC108A
BSX68	BSX68
BSX69	BSX69
BSX72	2N2219
BSX75	BSW41
BSX79	BCY59VII)
BSX80	(BSX68)
BSX81	(BSW33)
BSX95	BSX95
BSX96	BSX96
BSX97	2N2218
BSY10	(BF177)
BSY11	(BCY59VII)
BSY17	2N914
BSY18	(BSX20)
BSY19	BSX20
BSY21	BSX20
BSY34	(BSX61)
BSY40	BSY40
BSY41	BSY41
BSY44	BSX95
BSY45	2N1893
BSY46	(2N1893)
BSY51	BSY51
BSY52	BSY52
BSY53	BSY53
BSY54	BSY54
BSY55	BSY55
BSY56	BSY56

Type to be replaced	Replacement type
BSY58	2N2218
BSY59	(BC328)
BSY61	BC238A
BSY62	BSX20
BSY63	BSX20
BSY70	BSX19
BSY71	2N2219A
BSY72	(BC108A)
BSY73	BC108A
BSY74	BC108A
BSY75	2N2221
BSY76	2N2222
BSY77	(BSX21)
BSY78	(2N3019)
BSY79	BSY79
BSY80	BC108A
BSY81	(2N2218)
BSY	(2N2219)
BSY83	2N2218A
BSY84	2N2219A
BSY85	BSY85
BSY86	2N3019
BSY87	2N1893
BSY88	2N3019
BSY90	(2N2219)
BSY91	(BSX60)
BSY92	(2N2219A)
BSY93	2N2222
BSY95A	BC108A
BU104	(BU108)
BU105	BU105
BU108	BU108
BU109	(BU108)
BU111	(BU126)
BU120	(BDY98)

Type to be replaced	Replacement type
BU126	BU126
BUY12	(BDY91)
BUY13	(BDY91)
BUY14	(BDY61)
BUY16	(BDY90)
BUY17	(BDY60)
BUY26	(2N3442)
BUY51A	(2N3772)
GA004	ASY27
GT70	ASY26
ME0411	(BC307VI)
ME0412	(BC307A)
MJ423	(BDY96)
MJ431	(BDY96)
MJ1800	(BDY98)
MJ3029	(BDY95)
MJE101	(BD132)
MJE105	(BD132)
MJE201	(BD131)
MJE205	(BD131)
MJE340	(BD144)
MJE305	(2N3055)
MPS292	BC238B
MPS370	BC238
MPS653	BC237A
MPS6532	BC237A
MPS6533	(BC177IV)
MPS6534	(BC177A)
MPS6535	(BC177IV)
MPSU05	(BD137)
MPSU06	(BD139)
OC16	(AD162)
OC22	(AD149)
OC23	(AD149)

Type to be replaced	Replacement type
OC24	(AD149)
OC26	AD149
OC27	(AD149)
OC28	ASZ15
OC29	ASZ16
OC30A	AD162
OC30B	OC30B
OC35	ASZ17
OC36	ASZ18
OC42	(AC125)
OC44	(AF126)
OC45	(AF126)
OC46	(ASY26)
OC47	(ASY27)
OC65	(OC57)
OC66	(OC58)
OC70	(AC125)
OC71	(AC125)
OC72	(AC125)
OC74	(AC125)
OC75	(AC125)
OC76	(ASY76)
OC77	(ASY77)
OC79	(AC125)
OC80A	(AC126)
OC83	(AC128)
OC84	(AC128)
OC122	(ASY80)
OC123	(ASY77)
OC139	(ASY73)
OC140	(ASY29)
OC141	(ASY75)
OC169	(AF126)
OC171	(AF124)
OC200	(BC308VI)

REPLACEMENT GUIDE TRANSISTORS

Type to be replaced	Replacement type
OC201	(BC308VI)
OC202	(ASY27)
OC303	(AC125)
OC304-1	(AC125)
OC304-3	(AC125)
OC304-2	(AC125)
OC305-1	(AC126)
OC305-2	(AC126)
OC306-1	(AC125R)
OC406-2	(AC125R)
OC306-3	(AC125R)
OC307-1	(ASY76)
OC307-2	(ASY76)
OC307-3	(ASY80)
OC308	(ASY76)
OC309-1	(ASY77)
OC309-2	(ASY77)
OC309-3	(ASY80)
OC430	(BSY40)
OC440	(BC178VI)
OC443	(BC178VI)
OC445	(BC177VI)
OC449	(BC177VI)
OC450	(BSV68)
OC460	(BC178VI)
OC463	(BC178VI)
OC465	(BC178VI)
OC466	(BC178VI)
OC467	(BC178VI)
OC468	(BC178VI)
OC469	(BC177)
OC470	(BC178VI)
PBC107	BC237
PBC108	BC238
PBC109	BC239
SES3705	(BC337)
SFT223	ASY26
SFT229	ASY27
SFT321	AC125
SFT322	AC125
SFT323	AC125
SFT335	(AC125)
SFT351	AC125
SFT352	AC125
SFT353	AC125
TF65	(AC125)
TF78/30	(2N2904)
TF78/60	(2N2904)
TI3027	(ASZ16)
TI3028	(ASZ15)
TI3031	(ASZ15)
TIP29	(BD131)
TIP29A	(BD137)
TIP30	(BD132)
TIP30A	(BD138)
TIP31	(BD131)
TIP32	(BD132)
TIP33	(BDY38)
TIP33A	(2N3055)
TIS37	(BC308VI)
TIS38	(BC308VI)
TIS39	BFW17
2N85	(BSX19)
2N338	(BC107A)
2N526	ASY80
2N527	ASY80
2N696	2N2218A
2N697	2N2218A
2N698	(BSW67)
2N699	(BSW67)
2N706	BSX19
2N706A	BSX19
2N708	BSX19
2N709	(BSX19)
2N711	(AC125)
2N717	2N2221A
2N718	2N2221A
2N718A	2N2221A
2N726	(BC178VI)
2N727	(BC178VI)
2N731	2N2221A
2N733	2N2221A
2N735	2N2221
2N736	(2N2222A)
2N739	2N2221A
2N740	2N2222A
2N743	BSX19
2N744	BSX20
2N753	BSX20
2N760	(BCY59VII)
2N760A	2N2483
2N780	(BC107A)
2N834	BCY56
2N849	(BSX19)
2N850	(BSX20)
2N851	(BSX19)
2N914	BSX20)
2N915	2N2221A
2N916	BCY56
2N918	BSX19
2N929	2N929
2N930	2N930

Type to be replaced	Replacement type
2N956	(2N2222A)
2N1100	2N1100
2N1131	2N2904
2N1132	2N2904
2N1143	(ASY76)
2N1190S	BSW65
2N1252	2N2218
2N1253	2N2218
2N1274	(ASY26)
2N1302	ASY73
2N1303	ASY26
2N1304	ASY28
2N1305	ASY26
2N1306	ASY29
2N1307	ASY27
2N1308	ASY29
2N1309	ASY27
2N1420	2N2222
2N1479	(BFX34)
2N1480	(BFX34)
2N1481	(BFX34)
2N1482	(BFX34)
2N1487	BDY38
2N1488	BDY20
2N1489	BDY38
2N1490	BDY20
2N1507	2N2219
2N1565	2N2218
2N1566	2N2219
2N1566A	(BC141-10)
2N1572	(BF177)
2N1573	(BF178)
2N1574	(2N1893)
2N1613	2N1613
2N1617	(BDY91)
2N1618	(BDY90)
2N1700	BFY50
2N1711	2N2219A
2N1724	(2N4347)
2N1724A	(2N4347)
2N1725	(2N3055)
2N1889	BSW65
2N1890	(BSW66)
2N1893	2N1893
2N1924	ASY77
2N1925	(ASY77)
2N1926	(ASY77)
2N1990	BSX21
2N2102	2N2102
2N2192	2N2219A
2N2192A	2N2219A
2N2193	2N2218A
2N2193A	2N2218A
2N2194	2N2218A
2N2194A	2N2218A
2N2217	2N2218
2N2218	2N2218
2N2218A	2N2218A
2N2219	2N2219
2N2219A	2N2219A
2N2220	2N2221
2N2221	2N2221
2N2221A	2N221A
2N2222	2N2222
2N2222A	2N2222A
2N2243	BSW65
2N2270	2N2053
2N2297	BFY55
2N2315	2N2222
2N2368	2N2368
2N2369	2N2369
2N2369A	2N2369A
2N2387	(BC237A)
2N2388	(BC237A)
2N2396	(2N2221A)
2N2405	2N2405
2N1410	2N2218
2N2411	(BC178VI)
2N2412	(BC178VI)
2N2483	2N2483
2N2484	2N2484
2N2538	2N2219
2N2539	2N2222
2N2540	2N2222
2N2586	BC107A
2N2604	(BCY79IX)
2N2605	(BCY79X)
2N2614	(AC126)
2N2692	BCY70
2N2693	BCY70
2N2694	BC108A
2N2695	(BC328)
2N2696	2N2906
2N2712	(BC238A)
2N2822	—
2N2824	—
2N2825	—
2N2863	BFY51
2N2864	BFY51
2N2865	(BF180)
2N2883	BFW17
2N2884	BFW17
2N2890	BSW66
2N2891	(BD140)
2N2894	2N2894

REPLACEMENT GUIDE TRANSISTORS

Type to be replaced	Replacement type
2N2904	2N2904
2N2904A	2N2904A
2N2905	2N2905
2N2905A	2N2905A
2N2906	2N2906
2N2906A	2N2906A
2N2907	2N2907
2N2907A	2N2907A
2N2944	(BC178VI)
2N2945	(BC178VI)
2N2946	(2N2964)
2N3009	(BSX20)
2N3010	BSX19
2N3011	BSX20
2N3012	(BC178VI)
2N3013	(BSX20)
2N3014	(BSX20)
2N3015	2N2218
2N3019	2N3019
2N3020	2N3020
2N3033	(BF177)
2N3034	(BF177)
2N3055	(BC107A)
2N3036	(2N3019)
2N3037	(2N1893)
2N3038	(2N1893)
2N3053	2N3053
2N3054	2N3054
2N3055	2N3055
2N3114	BD115
2N3233	(2N4347)
2N3241A	(2N2222)
2N3252	BFY51
2N3253	(BSX59)
2N3261	BSX20
2N3299	2N2218
2N3303	2N3303
2N3304	BSX20
2N3375	BLY59
2N3391	BC238B
2N3392	BC238A
2N3402	(BC338)
2N3403	(BC338)
2N3404	(BC337)
2N3405	(BC337)
2N3414	(BC338
2N3415	(BC338)
2N3416	(BC337)
2N2317	(BC337)
2N3426	2N3426
2N3441	(2N3442)
2N3442	2N3442
2N3444	BSX61
2N3447	(BDY61)
2N3485	(2N2906A)
2N3485A	(2N2906)
2N3486	(2N2907A)
2N3486A	(2N2907)
2N3502	2N2905
2N3503	2N2905A
2N3504	2N2907
2N2505	2N2907A
2N3543	(BDY61)
2N3553	BFW47
2N3553	BSX60
2N3568	(BC337)
2N3570	(BFX89)
2N2572	(BFX89)
2N3585	(BDY94)
2N3615	(ASZ16)
2N2616	(ASZ15)
2N3617	(ASZ16)
2N3632	BLY60
2N3642	(BC337)
2N3644	(BC327)
2N3662	(BF200)
2N3700	2N3700
2N3701	2N3701
2N3702	(BC308VI)
2N3703	(BC307VI)
2N3704	BC337
2N3705	BC337
2N3706	BC338
2N3707	BC237A
2N3708	(BC237A)
2N3709	(BC237A)
2N3710	BC237A
2N3711	BC237B
2N3712	BD115
2N3724	BSX60
2N3725	BSX59
2N3738	(BU126)
2N3771	2N3771
2N3772	2N3772
2N3777	(2N4033)
2N3829	(2N3964)
2N3830	(BFX34)
2N3831	(BD131)
2N2832	BSY19
2N2855	BC238A
2N3856	BC238A
2N3866	2N3866
2N3877	(BF178)
2N3903	BC237A
2N3904	BC237A

Type to be replaced	Replacement type
2N3905	(BCY70)
2N3906	(BCY70)
2N3914	(2N2906)
2N3924	BFW46
2N3926	BLY57
2N3927	BLY58
2N3962	2N3963
2N3963	2N3963
2N3964	2N3964
2N4000	2N3019
2N4001	BSW66
2N4030	2N4030
2N4031	2N4031
2N4032	2N4032
2N4033	2N4033
2N4036	2N4036
2N4037	2N4037
2N4046	2N2218
2N4048	2N4048
2N4049	2N4049
2N4050	2N4050
2N4051	2N4051
2N4052	2N4052
2N4053	2N4053
2N4058	(BCY72)
2N4059	(BC308B)
2N4060	(BC308VI)
2N4061	(BC308A)
2N4062	(BC308B)
2N4264	(BC238A)
2N4265	(BC238A)
2N4286	BC238C
2N4289	(BC307B)
2N4347	2N4347
2N4393	(BSV68)
2N4402	BC307VI
2N4403	BC307A
2N4424	(BC337)
2N4425	(BC337)
2N4427	2N4427
2N4918	(BD132)
2N4919	(BD138)
2N4920	(BD140)
2N4921	(BD131)
2N4922	(BD137)
2N4923	(BD139)
2N4951	(BC337)
2N4952	(BC337)
2N4953	(BC337)
2N4954	(BC338)
2N5006	(BD183)
2N5036	(2N3055)
2N5037	(BD181)
2N5083	(2N3055)
2N5086	(BC307A)
2N5088	(BC237B)
2N5089	(BC239C)
2N5139	(BC308VI)
2N5147	(2N4031)
2N5148	BSW65
2N5149	(2N4033)
2N5150	(2N3019)
2N5151	(2N4031
2N5152	BSW65
2N5153	(2N4033)
2N5154	(2N3019)
2N5172	(BC237A)
2N5189	2N3053
2N5209	(BC237A)
2N5210	(BC237B)
2N5219	(BC239B)
2N5223	(BC239B)
2N5240	(BDY97)
2N5262	BFX34
2N5284	(BDY90)
2N5288	(BDY90)
2N5320	BSV94
2N5321	BSV93
2N5322	(2N4036)
2N5323	(2N4036)
2N5354	(BC328)
2N5355	(BC328)
2N5356	(BC328)
2N5365	(BC327)
2N5366	(BC328)
2N5367	(BC327)
2N5447	(BC328)
2N5550	(BF178)
2N5551	(BF178)
2N5655	(BF338)
2N5949	(BC337)
2SB370	(AC128)
2SC23C	(BD137)
2SC103	(BDY91)
2SC856	(BF178)
2SC897	(BDY90)
2SC917	(BF177)
40250	(BD131)
40251	(BDY38)
40314	BC140-10
40319	BC160-10
40360	2N3019
40361	BC141-10
40362	BC161-10
40408	(2N2218A)

REPLACEMENT GUIDE TRANSISTORS

Type to be replaced	Replacement type
40409	BSW65
40594	(BFX34)
40636	BD183

REPLACEMENT GUIDE SMALL SIGNAL DIODES

Type to be replaced	Replacement type
AA111	AA119
AA112	(AA119)
AA113	(AA119)
AA114	AA119
AA116	OA90
AA117	OA95
AA118	OA91
AA119	AA119
AA121	(OA90)
AA123	(OA90)
AA130	OA90
AA131	AA119
AA132	OA91
AA133	(OA91)
AA134	(OA91)
AA135	(AAZ17)
AA136	AAZ17
AA137	AA119
AA138	(OA91)
AA139	AAZ18
AA140	(OA90)
AA142	(AA119)
AA143	AA119
AA144	(AAZ15)
AAY13	(AAZ17)
AAY21	(OA90)
AAY27	(AAZ17)
AAY28	(AAZ15)
AAY30	(AAZ17)
AAY32	(AAZ17)
AAY33	(AAZ18)
AAY41	(AAZ17)
AAY47	(OA91)
AAY49	(AAZ17)
AAY53	(OA90)
AAY54	(OA90)
AAY55	(OA90)
AAZ10	(OA91)
AAZ12	(BAX12)
AAZ13	(AAZ18)
AAZ15	AAZ15
AAZ17	AAZ17
AAZ18	AAZ18
B60C1000	(BY164)
B280C1000	(BY179)
BA100	BAX16
BA101	(BA102)
BA102	BA102
BA103	(AAZ18)
BA104	(BAX16)
BA105	(BA145)
BA108	(BAX18)
BA110	(BB105G)
BA110G	(BB105G)
BA111	(BA102)
BA119	(BA102)
BA120	(BB105G)
BA121	(BB106)
BA124	(BA102BL)
BA125	(BA102JW)
BA127	(BAX13)
BA128	(BAX16)
BA129	(BA148)
BA130	(BAX13)
BA136	BA182
BA137	(BAX16)
BA139	(BB105A)
BA140	(BB105G)
BA141	(BB105A)
BA142	(BB105G)
BA143U	(BA182)
BA143V	(BA182)
BA145	BA145
BA147/50	(BAX13)
BA147/150	(BAX16)
BA147/230	(BAX17)
BA147/300	(BA145)
BA148	BA148
BA149	(BB105G)
BA150	(BA102)
BA152	(BA182)
BA161	(BB105A)
BA162	(BB105G)
BA163	(BB113)
BA165	BA182)
BA173	(BA145)
BA174	(BA182)
BA175	(BAV10)
BA176	OA91
BA177	(BA182)
BA182	BA182
BA184	(BA145)
BA185	(BA145)
BA186	(BA145)
BA187	1N4151
BA188	(BAX18)
BA189	(BAX16)
BA190	(BAX17)
BA195	(BAX17)
BA209	(BAW62)
BA211	(BAX13)
BA214	(BAX13)
BA243	(BA182)
BA244	(BA182)
BAV10	BAV10

REPLACEMENT GUIDE SMALL SIGNAL DIODES

Type to be replaced	Replacement type
BAV17	(BAX18)
BAV18	BAX18
BAV19	(BAX16)
BAV20	(BAX16)
BAV21	(BA148)
BAW24	(BAV10)
BAW25	(BAV10)
BAW26	(BAV10)
BAW27	(BAV10)
BAW33	(BAX12)
BAW56	BAW56
BAW57	(BAX12)
BAW57N	(BAX12)
BAW62	BAW62
BAX12	BAX12
BAX13	BAX13
BAX15	BAX15
BAX16	BAX16
BAX17	BAX17
BAX18	BAX18
BAX20	(BAV10)
BAX21	(BAV10)
BAX22	(BAX16)
BAX25	(BAX13)
BAX26	(BAX13)
BAX27	(BAV10)
BAX28	(3 × BAX13)
BAX30	(3 × BAX13)
BAX78	BAV10
BAY14	(BYX10)
BAY15	(BYX10)
BAY16	(BYX10)
BAY17	(BAV10)
BAY18	(BAV10)
BAY19	(BAX16)
BAY20	(BAX16)
BAY21	(BA145)
BAY23	(BYX10)
BAY24	(BYX10)
BAY25	(BYX10)
BAY32	BAX16
BAY33	BAX16
BAY38	BAW62
BAY39	BAX12
BAY41	(BAV10)
BAY42	(BAV10)
BAY43	(BAX12)
BAY44	(BAX16)
BAY45	(BAX16)
BAY46	(BA145)
BAY60	1N4154
BAY63	(BAV10)
BAY66	(BAY96)
BAY67	(BAV10)
BAY68	(BAV10)
BAY69	(BAV10)
BAY71	(BAW62)
BAY72	(BAV69)
BAY73	(BAV69)
BAY74	(BAW62)
BAY77	(BAV10)
BAY82	(BAX13)
BAY86	(BAX18)
BAY87	(BAX12)
BAY88	(BA145)
BAY89	(BYX10)
BAY90	(BYX10)
BAY91	(BYX10)
BAY92	(BYX10)
BAY93	(BAV10)
BAY94	(BAV10)
BAY95	(BAV10)
BAY96	BAY96
BAY98	(BAX16)
BAY99	(BAX12)
BB100	(BB105G)
BB100G	(BB105G)
BB103	(BB110G)
BB104BL	BB104B
BB104GN	BB104G
BB105A	BB105A
BB105B	BB105B
BB105G	BB105G
BB106	BB106
BB110	BB110
BB110SW	BB110SW
BB121	(BB106)
BB122	(BB106)
BO580	BY127
BY100	(BY127)
BY103	(BY127)
BY118	BYX71
BY122	(BY164)
BY123	(BY179)
BY127	BY127
BY133	(BY127)
BY134	(BY127)
BY135	(BY127)
BY140	BY176
BY144	(BY176)
BY145	(BY185
BY151N	(BY127)
BY152N	(BY127)
BY164	BY164
BY176	BY176

Type to be replaced	Replacement type
BY177	(BY127)
BY178	(BY127)
BY179	BY179
BY184	BY184
BY185	BY185
BY188	BY188
BYX10	BYX10
BYX28	BYX28
BYX29	BYX29
BYX32	BYX32
BYX36/150	BYX36/150
BYX36/300	BYX36/300
BYX36/600	BYX36/600
BYX38/120	BYX38/1200
BYX38/300	BYX38/300
BYX38/600	BYX38/600
BYX38/900	BYX38/900
BYX60/200	(BAX15)
BYX60/400	(BA145
BYY15	BYX52/900
BYY16	BYX52/900R
BYY31	(BY127)
BYY32	(BY127)
BYY33	(BY127)
BYY34	(BY127)
BYY35	(BY127)
BYY36	(BY127)
BYY37	(BY127)
BYY77	BYX52/1200
BYY78	BYX52/1200R
BYY88	(BY127)
BYY89	(BY127)
BYY90	(BY127)
BYY91	(BY127)
BYY92	(BY127)

Type to be replaced	Replacement type
BYZ10	BYX38/1200
BYZ11	BYX38/900
BYZ12	BYX38/600
BYZ13	BYX38/300
BYZ14	BYX52/600
BYZ15	BYX52/600R
BYZ16	BYX38/1200R
BYZ17	BYX38/900R
BYZ18	BYX38/600R
BYZ19	BYX38/300R
C1780	BY127
E11	(BY127)
E21	(BY127)
E41	(BY127)
E61	(BY127)
E81	(BY127)
E101	(BY127)
EM513	(BY127)
F42	(BY127)
F82	(BY127)
FB050	(BY164)
FD100	(BAX13)
FD111	(BAX13)
FD600	(BAV10)
FD700	(BAX13)
FD777	(BAX13)
FD6666	(BAV10)
FDH600	(BAV10)
FDH666	(BAX13)
FDH694	(BAX13)
FDN600	(BAW56)
FDN666	(BAW56)
FDR300	(BYX10)
FDR600	(BAV10)
FDR700	(BAX13)

Type to be replaced	Replacement type
G498	(AAZ17)
G498-1	(AAZ17)
G580	AAZ18
G1204	BYX38/1200
G1206	BYX38/1200
G6004	BYX38/600
G6006	BYX38/600
ITT600	(BAW62)
ITT601	1N4150
ITT700	(1N4150)
ITT777	(1N4150)
M0	(BAX12)
M12	(BAX12)
M14	(BAX12)
M22	(BA148)
M24	(BA148)
M34	(BA148)
M42	(BYX10)
M44	(BYX10)
M54	(BYX10)
M62	(BYX10)
M64	(BYX10)
M82	(BYX10)
M84	(BYX10)
M102	(BYX10)
M104	(BYX10)
MO50	(BAX12)
MO51	(BAX12)
MR21	(BA145)
MR31	(BA145)
MR41	(BYX10)
OA5	BAV10
OA7	BAV10
OA9	BAV10
OA47	(AAZ18)

REPLACEMENT GUIDE SMALL SIGNAL DIODES

Type to be replaced	Replacement type
OA70	OA90
OA72	AA119
OA73	AA119
OA79	AA119
OA81	OA91
OA85	OA95
OA86	(OA91)
OA87	OA95
OA90	OA90
OA91	OA91
OA92	OA95
OA95	OA95
OA127	AAZ18
OA128	(AAZ17)
OA129	(AAZ17)
OA130	(AAZ15)
OA131	(BAX15)
OA132	(BA145
OA150	OA91
OA159	AA119
OA160	OA90
OA161	(OA91)
OA172	AA119
OA174	OA91
OA180	(AAZ17)
OA182	(AAZ15)
OA200	BAX16
OA202	BAX16
OA210	(BY127)
OA214	(BY127)
SFD21	(OA90)
SFD43	(BAW56)
SFD83	(BAW56)
SFD84	(BAW62)
SFD86	BAX16
SFD89	BAX17
SFD037	(AA119)
SFD108	OA91
SFD122	AAZ18
SFD143	BAW62
SFD180	(BAV10)
SFD181	(BAX16)
SFD183	(BAW62)
SFD184	(BAW62)
TIV306	(BB105)
TIV307	(BB105)
TIV308	(BB105)
0100	(BAX12)
0307	(BY127)
0317	(BY127)
0327	(BY127)
0500	(BAX18)
0501	(BAX16)
0502	(BA145)
0504	(BYX10)
0507	(BYX10)
1N34	OA91
1N48	OA91
1N54A	OA91
1N60	AA119
1N64	AA119
1N65	OA95
1N70	OA95
1N87A	AA119
1N198	OA91
1N424A	(BAX16)
1N456	(BAW62)
1N459	(BAX17)
1N485B	(BAX17)
1N537	(BY127)
1N541	AA119
1N643	(BAX16)
1N649	(BYX10)
1N658	(BAX16)
1N659	BAX16
1N660	BAX16
1N661	(BAX16)
1N662	BAX16
1N663	BAX16
1N914	1N914
1N914A	1N914A
1N914B	1N914B
1N915	BAW62
1N916	1N916
1N916A	1N916A
1N916B	1N916B
1N917	BAW62
1N2069	(BYX36/600)
1N2070	(BY127)
1N2071	(BY127)
1N3062	BAW62
1N3063	BAW62
1N3064	BAX16
1N3070	(BAX16)
1N3282	(BYX10)
1N3283	(BYX10)
1N3592	AAZ18
1N3595	(BAX15)
1N3600	(BAX12)
1N3754	(BY127)
1N3880	BYX50/200
1N3881	BYX50/200
1N3883	BYX50/400
1N3890	BYX30/200
1N3891	BYX30/200

Type to be replaced	Replacement type
1N3893	BYX30/400
1N4001	(BY127)
1N4002	(BY127)
1N4003	(BY127)
1N4004	(BY127)
1N4005	(BY127)
1N4006	(BY127)
1N4007	(BY127)
1N4148	1N4148
1N4149	1N4148
1N4150	1N4150
1N4151	1N4151
1N4152	(BAV10)
1N4153	(BAV10)
1N4154	1N4154
1N4244	(BA182)
1N4376	(BAX13)
1N4383	(BY127)
1N4385	BY127
1N4446	1N4446
1N4447	1N4446
1N4448	1N4448
1N4449	1N4448
1N4450	(BAV10)
1N4454	(1N914)
1N4531	(BAW56)
1N4532	(BAW56)
1N4585	BY127
1N4606	(BAV10)
1N4607	(BAV10)
1N4610	(BAV10)
1N4727	(BAV10)
1N4940	(BAX12)
1N5220	(BAX13)
1N5282	(BAV10)

Type to be replaced	Replacement type
1N5317	(BAV10)
1N5318	(BAV10)
1N5319	(BAV10)
1N5427	(BAX13)
1N5428	(BAX17)
1N5429	(BAX16)
1N5430	(BAX12)
1N5431	(BAV10)
1N5432	(BAX13)
1S920	(BA148)
1S921	(BA148)
1S922	(BA148)
1S923	BA148)
15P2	(BAV10)
16P2	(BAV10)
18J2F	(BY127)
18P2	(BAV10)
19P2	(BAV10)
40PJ	(OA90)
547J2F	(BY127)
66J2	(BY127)
85P1	(OA95)

REPLACEMENT GUIDE VOLTAGE REGULATOR AND REFERENCE DIODES

Type to be replaced	Replacement type
BZ100	BZY88-C3V9
BZ102-1V4	BZX75-C1V4
-2V1	-C2V1
-2V8	-C2V8
-3V4	(BZY88-C3V3)
BZX10	BZX79-C6V2
BZX11	-C6V8
BZX12	-C7V5
BZX13	-C8V2
BZX14	-C9V1
BZX15	BZX79-C10
BZX16	-C11
BZX17	-C12
BZX18	-C13
BZX19	-C15
BZX20	BZX79-C16
BZX21	-C18
BZX22	-C20
BZX23	-C22
BZX24	-C24
BZX25	BZX79-C27
BZX26	-C30
BZX27	-C33
BZX29	BZX61
BZX48	BZX48
BZX49	BZX49
BZX50	BZX50
BZX55-C5V6	BZX79-C5V6
-C6V2	-C6V2
-C6V8	-C6V8
BZX55-C7V5	BZX79-C7V5
-C8V2	-C8V2
-C9V1	-C9V1
-C10	-C10
-C11	-C11
BZX55-C12	BZX79-C12
-C13V5	-C13
-C15	-C15
-C16V5	-C16
-C18	-C18
BZX55-C20	BZX79-C20
-C22	-C22
-C24V5	-C24
-D	-C...
BZX61	BZX61-C...
BZX67-C12	(BZY93-C12)
-C13	-C13)
-C15	-C15)
-C16	-C16)
-C18	-C18)
BZX67-C20	(BZY93-C20)
-C22	-C22)
-C24	-C24)
-C27	-C27)
-C30	-C30)
BZX67-C33	(BZY93-C33)
-C36	-C36)
-C39	-C39)
-C43	-C43)
-C47	-V47)
BZX67-C51	(BZY93-C51)
-C56	-C56)
-C62	-C62)
-C68	-C68)
-C75	-C75)
BZX70	BZX70-C...
BZX71B	(BZX79-C...)
C	-C...
-C5V1	BZX79-C5V1
-C5V6	-C5V6)
BZX71-C6V2	BZX79-C6V2
C6V8	BZY79-C6V8
BZX75-C1V4	BZX75-V1V4
-C2V1	-C2V11
-C2V8	-C2V8
BZX75-C3V6	BZX75-C3V6
BZX79	BZX79-C...
BZX84	BZX84-C...
BZY78	BZY78
BZY83C	(BZX79-C...)
BZY83D	(BZX79-C...)
BZY85-C2V7	(BZX75-C2V8)
-C3	-C2V8)
-C3V3	BZY88-C3V3
-C3V6	-C3V6
BZY85-C3V9	BZY88-C3V9
-C4V3	-C4V3
-C4V7	BZX79-C4V7
-C5V1	-C5V1
-C5V6	-C5V6
BZY85-C6V2	BZX79-C6V2
-C6V8	-C6V8
-C7V5	-C7V5
-C8V2	-C8V2
-C9V1	-C9V1
BZY85-C10	BZX79-C10
-C11	-C11
-C12	-C12
-C13V5	-C13
-C15	-C15
BZY85-C16V5	BZX79-C16
-C18	-C18
-C20	-C20
-C22	-C22
-C24V5	-C24

Type to be replaced	Replacement type
BZY85D	BZX79-C...
BZY88	-C
BZY91	BZY91-C...
BZY92-C3V9	(BZY88-C3V9)
-C4V3	-C4V3)
BZY92-C4V7	(BZY96-C4V7)
-C5V1	-C5V1)
-C5V6	(BZX79-C5V6)
-C6V2	-C6V2)
-C6V8	-C6V8)
BZY92-C7V5	BZX61-C7V5
C8V2	-C8V2
-C9V1	-C9V1
-C10	-C10
-C11	-C11
BZY92-C12	BZX61-C12
-C13	-C13
-C15	-C15
-C16	-C16
-C18	-C18
BZY92-C20	BZX61-C20
-C22	-C22
-C24	-C24
-C27	-C27
-C30	-C30
BZY92-C33	BZX61-C33
-C36	-C36
BZY93	BZY93-C...
BZY95	BZY95-C...
BZY96	BZY96-C...
BZZ10	(BZX79-C6V2)
BZZ11	-C6V8)
BZZ12	-C7V5
BZZ13	-C8V2)
MZ4615	(BZX75-C2V1)
MZ4616	(BZX75-C2V1)
MZ4618	-C2V8)
MZ4619	-C2V8)
MZ4620	BZY88-C3V3
MZ4621	-C3V6
MZ4622	BZY88-C3V9
MZ4623	-C4V3
MZ4624	BZX79-C4V7
MZ4625	-C5V1
MZ4626	-C5V6
MZ4627	BZX79-C6V2
OA126-4	(BZY88-C3V9)
OA126-5	(BZX79-C5V1)
OA126-6	-C6V2)
OA126-7	-C6V8)
OA126-8	(BZX79-C8V2)
OA126-9	-C9V1)
OA126-10	BZX79-C10
OA126-11	-C11
OA126-12	-C12
OA126-14	(BZX79-C15)
OA126-18	-C18)
OAZ200	-C4V7)
OAZ201	-C5V1)
OAZ202	-C5V6)
OAZ203	BZX79-C6V2
OAZ204	-C6V8
OAZ205	-C7V5
OAZ206	-C8V2
OAZ207	-C9V1
OAZ208	BZX79-C5V1
OAZ209	-C5V6
OAZ210	(BZX79-C6V2)
OAZ211	-C7V5)
OAZ212	-C9V1)
OAZ213	BZX79-C12
RD4,7A	(BZY96-C4V7)
RD5,1A	-C5V1)
RD5,6A	BZX29-C5V6
RD6,2A	-C6V2
RD6,8A	BZX61-C6V8
RD7,5A	-C7,5–39
RF2,7B	(BZX75-C2V8)
RF3B	-C2V8)
RF3,3B	BZY88-C3V3
RF3,6B	BZX79-C3,6–30
RZ10A	(BZY91-C10)
RZ12	-C12)
RZ15A	-C15)
RZ18A	-C18)
RZ22A	(BZY91-C22)
RZ27A	-C27)
RZ33A	-C33)
RZ39A	-C39)
RZ47A	-C47)
RZ56A	(BZY91-C56)
RZ68A	-C68)
RZ82A	-C75)
Z3	(BZY88-C3V6)
Z4	BZX79-C4V7)
Z5	(BZX79-C5V6)
Z6	-C6V8)
Z7	-C7V5)
Z8	-C8V2)
Z10	-C10)
Z12	(BZX79-C12)
Z15	-C15)
Z18	-C18)
Z22	-C22)
ZD3,9	(BZY88-C3V9)

REPLACEMENT GUIDE VOLTAGE REGULATOR AND REFERENCE DIODES

Type to be replaced	Replacement type
ZD4,3	(BZY88-C4V3)
ZD4,7	(BZX79-C4V7)
ZD5,1	-C5V1)
ZD5,6	BZX29-C5V6
ZD6,2	-C6V2
ZD6,8	BZX61-C6V8
ZD7,5	-C7V5
ZD8,2	-C8V2
ZD9,1	-C9V1
ZD10	-C10
ZD11	BZX61-C11
ZD12	-C12
ZD13	-C13
ZD15	-C15
ZD16	-C16
ZD18	BZX61-C18
ZD20	-C20
ZD22	-C22
ZD24	-C24
ZD27	-C27
ZD30	BZX61-C30
ZD33	-C33
ZD36	-C36
ZD39	-C39
ZD43	-C43
ZD47	BZX61-C47
ZD51	-C51
ZD56	-C56
ZD62	-C62
ZD68	-C68
ZD75	BZX61-C75
ZE1,5	(BZX75-C1V4)
ZE2	-C2V1)
ZF2,7	-C2V8)
ZF3	-C2V8)

Type to be replaced	Replacement type
ZF3,3	BZY88-C3V3
ZF3,6	-C3V6
ZF3,9	-C3V9
ZF4,3	-C4V3
ZF4,7	BZX79-C4V7
ZF5,1	BZX79-C5V1
ZF5,6	-C5V6
ZF6,2	-C6V2
ZF6,8	-C6V8
ZF7,5	-C7V5
ZF8,2	BZX79-C8V2
ZF9,1	-C9V1
ZF10	-C10
ZF11	-C11
ZF12	-C12
ZF13	BZX79-C13
ZF15	-C15
ZF16	-C16
ZF18	-C18
ZF20	-C20
ZF22	BZX79-C22
ZF24	-C24
ZF27	-C27
ZF30	-C30
ZF33	-C33
ZL3,9	(BZY88-C3V9)
ZL4,7	(BZY96-C4V7)
ZL5	-C5V6)
ZL5,6	(BZX29-C5V6)
ZL6	(BZY96-C6V8)
ZL6,8	(BZX29-C6V8)
ZL7	(BZY96-C7V5)
ZL7,5K	(BZY93...)
ZL8	(BZY96-C8V2)
ZL8,2	(BZX61-C8V2)

Type to be replaced	Replacement type
ZL10	(BZX61-C10)
ZL12	-C12)
ZL15	-C15)
ZL18	-C18)
ZL22	-C22)
ZL27	(BZX61-C27)
ZL33	-C33)
ZL39	-C39)
ZL47	-C47)
ZL56	-C56)
ZL68	(BZX61-C68)
ZL82	-C82)
ZM3,9	(BZX79-C3V9)
ZM4,7	(BZY96-C4V7)
ZM5,6	(BZX79-C5V6)
ZM6,8	(BZX79-C6V8)
ZM8,2	BZX61-C8V2
ZM10	-C10
ZM12	-C12
ZM15	-C15
ZM18	BZX61-C18
ZM22	-C22
ZM27	-C27
ZM33	-C33
ZM39	-C39
ZM47	BZX61-C47
ZM56	-C56
ZM68	(BZY95-C68)
ZP2,7	(BZX75-C2V8)
ZP3	-C2V8)
ZP3,3	BZY88-C3V3
ZP3,6	-C3V6
ZP3,9	-C3V9
ZP4,3	-C4V3
ZP4,7	-C4V7

Type to be replaced	Replacement type
ZP5,6	BZX79-C5V6
ZP6,2	-C6V2
ZP6,8	-C6V8
ZP7,5	-C7V5
ZP8,2	-C8V2
ZP9,1	BZX79-C9V1
ZP10	-C10
ZP11	-C11
ZP12	-C12
ZP13	-C13
ZP15	BZX79-C15
ZP16	-C16
ZP18	-C18
ZP20	-C20
ZP22	-C22
ZP24	BZX79-C24
ZP27	-C27
ZP30	-C30
ZP33	-C33
ZX5.6	(BZX79-C5V6)
ZX6,2	(BZX79-C6V2)
ZX6,8	(BZX61-C6V8)
ZX7,5	-C7V5)
ZX8,2	-C8V2)
ZX9,1	-C9V1)
ZX10	(BZX61-C10)
ZX11	-C11)
ZX12	-C12)
ZX13	-C13)
ZX15	-C15)
ZX16	(BZX61-C16)
ZX18	-C18)
ZX20	-C20)
ZX22	-C22)
ZX24	-C24)

Type to be replaced	Replacement type
ZX27	(BZX61-C27)
ZX30	-C30)
ZX33	-C33)
ZX36	-C36)
ZX39	-C39)
ZX43	(BZX61-C43)
ZX47	-C47)
ZX51	-C51)
ZX56	-C56)
ZX62	(BZY95-C62)
ZX68	(BZY95-C68)
ZX75	-C75)
1N708	BZX79-C5V6
1N709	-C6V2
1N710	(BZX79-C6V8)
1N711	(BZX79-C7V5)
1N712	-C8V2)
1N713	-C9V1)
1N714	-C10
1N715	-C11)
1N716	(BZX79-C12)
1N717	-C13)
1N718	-C15)
1N719	-C16)
1N720	-C18)
1N721	(BZX79-C20)
1N722	-C22)
1N723	-C24)
1N724	-C27)
1N725	-C30)
1N726	(BZX79-C33)
1N727	-C36)
1N728	-C39)
1N729	-C43)
1N730	-C47)

Type to be replaced	Replacement type
1N731	(BZX79-C51)
1N732	(BZX61-C56)
1N733	-C62)
1N734	-C68)
1N735	-C75)
1N746	BZY88-C3V3
1N747	-C3V6
1N748	-C3V9
1N749	-C4V3
1N750	BZX79-C4V7
1N751	BZX79-C5V1
1N752	-C5V6
1N753	-C6V2
1N754	-C6V8
1N755	-C7V5
1N757	BZX79-C9V1
1N758	-C10
1N759	C12
1N957B	-C6V8
1M958B	-C7V5
1N959A	BZX79-C8V2
1N960A	-C9V1
1N961A	-C10
1N961B	-C10
1N962A	-C11
1N963A	BZX79-C12
1N964A	-C13
1N964B	-C13
1N965A	-C15
1N966A	-C16
1N967A	BZX79-C18
1N968A	-C20
1N969A	-C22
1N970A	-C24
1N971A	-C27

REPLACEMENT GUIDE VOLTAGE REGULATOR AND REFERENCE DIODES

Type to be replaced	Replacement type
1N971B	BZX79-C27
1N972A	-C30
1N973B	-C33
1N974B	-C36
1N975B	-C39
1N976B	BZX79-C43
1N977B	-C47
1N978B	-C51
1N979B	-C56
1N1816A	BZY93-C13
1N1817A	BZY93-C15
1N1818A	-C16
1N1819A	-C18
1N1820A	-C20
1N1821A	-C22
1N1822A	BZY93-C24
1N1823A	-C27
1N1824A	-C30
1N1825A	-C33
1N1826A	-C36
1N1827A	BZY93-C39
1N1828A	-C43
1N1829A	-C47
1N1830A	-C51
1N1831A	-C56
1N1832A	BZY93-C62
1N1833A	-C68
1N1834A	-C75
1N2808A	(BZY91-C10)
1N2809A	-C11–75)
1N2971A	BZY93-C7V5
1N2971B	-C7V1
1N2972A	-C8,2–75
1N2972B	-C8V2
1N2973B	-C9,1
1N2974B	BZY93-C10
1N2975B	-C11
1N2976B	-C12
1N2977B	-C13
1N2979B	-C15
1N2980B	BZY93-C16
1N2984B	-C20
1N2985B	-C22
1N2986B	-C24
1N2988B	-C27
1N2989B	BZY93-C30
1N2990B	-C33
1N2991B	-C36
1N2992B	-C39
1N2993B	-C43
1N2995B	BZY93-C47
1N2997B	-C51
1N2999B	-V56
1N3000B	-C62
1N3001B	-C68
1N3002B	BZY93-C75
1N3016B	(BZX61-C6V8)
1N3017B	-C7V5)
1N3018B	-C8V2)
1N3019B	-C9V1)
1N3020B	(BZX61-C10)
1N3021B	-C11)
1N3022B	-C12)
1N3023B	-C13)
1N3024B	-C15)
1N3025B	(BZX61-C16)
1N3026B	-C18)
1N3027B	-C20)
1N3028B	-C22)
1N3029B	-C24)
1N3030B	(BZX61-C27)
1N3031B	-C30)
1N3021B	-C33)
1N3033B	-C36)
1N3034B	-C39)
1N3035B	(BZX61-C43)
1N3036B	-C47)
1N3037B	-C51)
1N3038B	-C56)
1N3039B	-C62)
1N3040B	(BZX61-C68)
1N3041B	-C75)
1N3309B	BZY91-C10
1N3310B	-C11
1N3311B	-C12
1N3312B	BZY91-C13
1N3314B	-C15
1N3315B	-C16
1N3317B	-C18
1N3319B	-C20
1N3320B	BZY91-C22
1N3321B	-C24
1N3323B	-C27
1N3324B	-C30
1N3325B	-C33
1N3326B	BZY91-C36
1N3327B	-C39
1N3328B	-C43
1N3330B	-C47
1N3332B	-C51
1N3334B	BZY91-C56
1N3335B	-C62
1N3336B	-C68
1N3337B	-C75
1N3785B	(BZX29-C6V8)

Type to be replaced	Replacement type
1N3786B	(BZX61-C7V5)
1N3787B	-C8V2)
1N3788B	-C9V1)
1N3789B	-C10)
1N3790B	-C11–56)
1N3808B	(BZY95-C62)
1N3809B	-C68)
1N3810B	-C75)
1N4000A	BZY93-C7V5
1N4099	BZX79-C
1N4100	BZX79-C
1N4101	-C8V2
1N4103	-C9V1
1N4104	-C10
1N4105	-C11
1N4106	BZX79-C12
1N4107	-C13
1N4109	-C15
1N4110	-C16
1N4112	-C18
1N4114	BZX79-C20
1N4115	-C22
1N4116	-C24
1N4117	–
1N4118	-C27
1N4120	BZX79-C30
1N4158B	BZX61-C6V8
1N4159B	-C7V5
1N4160B	-C8V2
1N4161B	-C9V1
1N4162B	BZX61-C10
1N4163B	-C11
1N4164B	-C12
1N4165B	-C13
1N4166B	-C15
1N4167B	BZX61-C16
1N4168B	-C18
1N4169B	-C20
1N4170B	-C22
1N4171B	-C24
1N4172B	BZX61-C27
1N4173B	-C30
1N4174B	-C33
1N4175B	-C36
1N4176B	-C39
1N4177B	BZX61-C43
1N4178B	-C47
1N4179B	-C51
1N4180B	-C56
1N4181B	-C62
1N4182B	BZX61-C68
1N4183B	-C75
1N4371	(BZX75-C2V8)
1N4372	-C2V8)
1N4732	(BZY96-C4V7)
1N4733	(BZY96-C5V1)
1N4734	-C5V6)
1N4735	-C6V2)
1N4736	(BZX61-C6V8)
1N4737	-C7V5)
1N4738	(BZX61-C8V2)
1N4739	-C9V1)
1N4740	-C10)
1N4741	-C11)
1N4742	-C12)
1N4743	(BZX61-C13)
1N4744	-C15)
1N4745	-C16)
1N4746	-C18)
1N4747	-C20)
1N4748	(BZX61-C22)
1N4749	-C24)
1N4750	-C27)
1N4751	-C30)
1N4752	-C33)
1N4753	(BZX61-C36)
1N4754	-C39)
1N4755	-C4)
1N4756	-C47)
1N4757	-C51)
1N4758	(BZX61-C56)
1N4759	-C62)
1N4760	-C68)
1N4761	-C75)
1N4831B	BZX61-C9V1
1N4832B	BZX61-C10
1N4833B	-C11
1N4834B	BZX61
1N4835B	BZX61
1N4836B	BZX61
1N4837B	BZX61
1N4838B	BZX61
1N4839B	BZX61
1N4840B	BZX61
1N4841B	BZX61
1N4842B	BZX61
1N4843B	BZX61
1N4844B	BZX61
1N4845B	BZX61
1N4846B	BZX61
1N4847B	BZX61
1N4848B	BZX61
1N4849B	BZX61
1N4850B	BZX61
1N4851B	BZX61

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Type to be replaced	Replacement type
1N4852B	BZX61
1N4853B	BZX61
1N5224B	BZX75-C2V8
1N5226B	BZY88-C3V3
1N5227B	-C3V6
1N5228B	BZY88-C3V9
1N5229B	-C4V3
1N5230B	BZX79-C4V7
1N5231B	-C5V1
1N5232B	-C5V6
1N5234B	BZX79-C6V2
1N5235B	-C6V8
1N5236B	-C7V5
1N5237B	-C8V2
1N5239B	-C9V2
1N5240B	BZX79-C10
1N5241B	-C11
1N5242B	-C12
1N5243B	-C13
1N5245B	-C15
1N5246B	BZX79-C16
1N5248B	-C18
1N5250B	-C20
1N5251B	-C22
1N5252B	-C24
1N5254B	BZX79-C27
1N5256B	-C30
1N5257B	-C33
1N5258B	-C36
1N5259B	-C39
1N5260B	BZX79-C43
1N5261B	-C47
1N5262B	-C51
1N5263B	-C56
1N5265B	-C62

Type to be replaced	Replacement type
1N5266B	BZX79-C68
1N5267B	-C75
1N5343A	(BZY93-C7V5)
1N5343B	-C7V5)
1N5344A	-C8–75)
1N5344B	(BZY93-C8–75)
1N5502	BZX75-C1V4
11Z6	(BZY88-C3V3)
12Z6	-C3V6)
13Z6	-C3V9)
14Z6	(BZY88-C4V3)
15Z6	-C4V7)
16Z6	-C5V1)
17Z6	-C5V6)
18Z6	-C6V2)
19Z6	BZX61-C6V8
20Z6	-C7V5
21Z6	-C8V2
22Z6	-C9V1
23Z6	-C10
24Z6	BZX61-C11
25Z6	-C12
26Z6	-C13
28Z6	-C15
31Z6	BZY88-C3V3
32Z6	BZY88-C2V6
33Z6	-C3V9
34Z6	-C4V3
35Z6	-C4V7
36Z6	-C5V1
37Z6	BZY88-C5V6
38Z6	-C6V2
39Z6	-C6V8
40Z6	-C7V5
41Z6	-C8V

Type to be replaced	Replacement type
42Z6	BZY88-C9
43Z6	-C10
60Z6	(BZY93-C7V5)
61Z6	-C8V2)
62Z6	-C9V1)
63Z6	(BZY70-C10)
64Z6	-C11)
65Z6	-C12)
66Z6	-C13)
67Z6	-C14)
68Z6	(BZY70-C15)
80Z6	(BZY93-C7V5)
81Z6	-C8V2)
82Z6	-C9V1)
83Z6	-C10)
84Z6	(BZY93-C11)
85Z6	-C12)
86Z6	-C13)
88Z6	-C15)
1101	(BZY75-C2V8)
1102	(BZY88-C3V3)
1103	-C3V9)
1104	-C4V7)
1105	-C5V6)
1106	-C6V8)
1107	(BZY88-C7V5)
1108	-C8V2)
1109	-C9V1)
1110	-C10)
1111	-C11)
1112	(BZY88-C12)
1113	-C13)
1115	-C15)
1116	-C16)
1118	-C18)

Type to be replaced	Replacement type
1120	(BZY88-C20)
1122	-C22)
1124	-C24)
1127	-C27)
1130	-C30)
1133	(BZX79-C33)
1204	(BZY96-C4V7)
1205	-C5V6)
1206	-C6V8)
1207	(BZY93-C6V7)
1208	(BZY93-C8V2)
1209	-C9V1)
1210	-C10)
1211	-C11)
1212	-C12)
1213	(BZY93-C13)
1215	-C15)
1216	-C16)
1218	-C18)
1220	-C20)
1222	(BZY93-C22)
1224	-C24)
1227	-C27)
1230	-C30)
1233	-C33)
1236	(BZY93-C36)
1239	-C39)
1243	-C43)
1247	-C47)
1305	(BZX29-C5V6)
1305K3	(BZX70)
1305K6	(BZX93)
1306	(BZX61-C6V8)
1307	-C7V5)
1308	-C8V2)
1309	(BZX61-C9V1)
1310	-C10)
1311	-C11)
1312	-C12)
1313	-C13)
1315	(BZX61-C15)
1316	-C16)
1318	-C18)
1320	-C20)
1322	(C22)
1324	(BZX61-C24)
1327	-C27)
1330	-C30)
1333	-C33)
1336	-C36)
1339	(BZX61-C39)
1343	-C43)
1347	-C47)
4120	(BZY93-C10)
4121	-C11)
4122	(BZY93-C12)
4123	-C13)
4124	-C15)
4125	-C16)
4126	-C18)
4127	(BZY93-C20)
4128	-C22)
4129	-C24)
4130	-C27)
4131	-C30)
4132	(BYZ93-C33)
4133	-C36)
4134	-C39)
4135	-C43)
4136	-C47)
4137	(BZY93-C51)
4138	-C56)
4139	-C62)
4140	-C68)
4141	-C75)
4220	(BZY93)
4320	(BZY93-C10)
4321	-C11)
4322	-C12)
4323	-C13)
4324	(BZY93-C15)
4325	-C16)
4326	-C18)
4327	-C20)
4328	-C22)
4329	(BZY93-C24)
4330	-C27)
4331	-C30)
4332	-C33)
4333	-C36)
4334	(BZY93-C39)
4335	-C43)
4336	-C47)
4337	-C51)
4338	-C56)
4339	(BZY93-C62)
4340	-C68)
4341	-C75)
4420	(BZY93)
4520	(BZY91-C10)
4521	(BZY91-C11)
4522	-C12)
4523	-C15)
4524	-C15)
4525	-C16)

REPLACEMENT GUIDE VOLTAGE REGULATOR AND REFERENCE DIODES

Type to be replaced	Replacement type
4526	(BZY91-C18)
4527	-C20)
4528	-C22)
4529	-C24)
4530	-C27)
4531	(BZY91-C30)
4532	-C33)
4533	-C36)
4534	-C39)
4535	-C43)
4536	(BZY91-C47)
4537	-C51)
4538	-C56)
4539	-C62)
4540	-C68)
4541	(BZY91-C75)
4620	(BZY91)
5320	(BZX61-C10)
5320K3	(BZX70-C...)
5320K6	(BZY93...)
5321	(BZX61-C11)
5322	-V12)
5323	-C13)
5324	-C15)
5325	-C16)
5326	(BZX61-C18)
5327	-C20)
5328	-C22)
5329	-C24)
5330	-C27)
5331	(BZX61-C30)
5332	-C33)
5333	-C36)
5334	-C39)
5335	-C43)
5336	(BZX61-C47)
5337	-C51)
5338	-C56)
5339	-C62)
5340	-C68)
5341	(BZX61-C75)
5506	BZX75-C2V8
5508	BZY88-C3V3
5509	-C3V6
5510	-C3V9
5511	BZY88-C4V3
5512	BZX79-C4V7
5513	-C5V1
5514	-C5V6
5515	-C6V2
5516	BZX79-C6V8
5517	-C7V5
5518	-C8V2
5519	-C9V1
5520	(BZX79-(C10)
5521	BZX79-C11
5522	-C12
5523	-C13
5524	-C15
5525	-C16
5526	BZX79-C18
5527	-C20
5528	-C22
5529	-C24
5530	-C27
5531	BZX79-C30
5532	-C33
5533	-C36
5534	-C39
5535	-C43
5536	BZX79-C47
5537	-C51
5538	-C56
5539	-C62
5540	-C68
7706	(BZX75-C2V8)
7707	-C2V8)
7708	(BZY88-C3V3)
7709	-C3V6)
7710	(BZY88-C3V9)
7711	-C4V3)
7712	-C4V7)
7713	-C5V1
7714	BZX29-C5V6
7715	BZX29-C6V2
7716	BZX61-C6V8
7717	-C7V5
7718	-C8V2
7719	-C9V1
7720	BZX61-C10
7721	-C11
7722	-C12
7723	-C13
7724	-C15
7725	BZX61-C16
7726	-C18
7727	-C20
7728	-C22
7729	-C24
7730	BZX61-C27
7731	-C30
7732	-C33
7733	-C36
7734	-C39

Type to be replaced	Replacement type
7735	BZX61-C43
7736	-C47
7737	-C51
7738	-C56
7739	-C62
7740	BZX61-C68
7741	-C75
9970	(BZX75-C2V8)
9971	(BZY88-C3V6)
9972	-C4V3)
9973	(BZX79-C5V1)
9974	-C6V2)
9980	(BZX75-C2V8)
9981	-C3V6)
9982	(BZY88-C4V3)
9983	(BZX79-C5V1)
9984	-C6V2)
9992	(BZY88-C4V3)
9993	BZY96-C5V1
9994	(BZX79-C6V2)

REPLACEMENT GUIDE INTEGRATED CIRCUITS

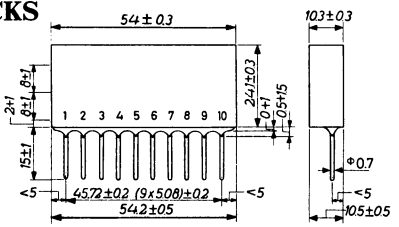
Type to be replaced	Replacement type
SAA700	(TAA700)
SF252	FHJ101A
SF253	FHJ101B
SF262	FHJ121A
SF263	FHJ121B
SG212	FHH181A
SG213	FHH181B
SG222	FHH141A
SG223	FHH141B
SG232	FHY101
SG242	FHH121A
SG243	FHH121B
SG252	FHH161A
SG253	GHH161B
SG262	FHH101A
SG263	FHH101B
SG322	FHH201A
SG323	FHH201B
SM62	FHJ141A
SM63	FHJ141B
SN7400N	FJH131
SN7401N	FJH231
SN7401-S1	FJH311
SN7402N	FJH221
SN7403N	FJH291
SN7404N	FJH241
SN7405N	FJH251
SN7405-S1	FJH321
SN7410N	FJH121
SN7413N	FJL131
SN7420N	FJH111
SN7426N	FJH301
SN7430N	FJH101
SN7440N	FJH141
SN7441N	FJL101
SN7442N	FJH261
SN7450N	FJH151
SN7451N	FJH161
SN7453N	FJH171
SN7454N	FJH181
SN7460N	FJY101
SN7470N	FJJ101
SN7472N	FJJ111
SN7473N	FJJ121
SN7474N	FJJ131
SN7475N	FJJ181
SN7476N	FJJ191
SN7480N	FJH191
SN7482N	FJH201
SN7483N	FJH211
SN7486N	FJH271
SN7490N	FJJ141
SN7491AN	FJJ151
SN7492N	FJJ251
SN7493N	FJJ211
SN7496N	FJJ241
SN74107N	FJJ261
SN74118N	FJJ291
SN74119N	FJJ301
SN74121N	FJK101
SN74151N	FJH441
SN74154N	FJH341
SN74155N	FJH491
SN74170N	FJQ101
SN74180N	FJH281
SN74181N	FJH451
SN74191N	FJJ401
SN74193N	FJJ411
SN76210	TBA500
SN76540	TAA700
SN76550	TAA550
SN76630	TAA630
SN76640	TAA640
TAA131	(OM200)
TAA141	(TAA263)
TAA151	(TAA293)
TAA750	(TAA320)
TAA940	(TAA550)
TBA271	(TAA550)
TBA311	(TAA700)
μA702A	TAA242
μA702C	TAA241
μA709	TAA522
μA709C	TAA521
μA723C	TBA281
μA741	TBA222
μA741C	TBA221
μA784	TAA640
μA785	TAA700
μA786	TAA630
ZTK33	(TAA550)

COMPONENTS AND MATERIALS

CIRCUIT BLOCKS

Circuit blocks 1-Series

Maximum pulse repetition frequency = 100 kHz, for triggered logic applications
Supply: $V_P = +6\ V \pm 5\%$, $V_N = -6\ V \pm 5\%$
Ambient temperature range: -20 to $+60°C$
Logic levels:
binary "1": 0.7 V_N to V_N
binary "0": 0 to -0.2 V



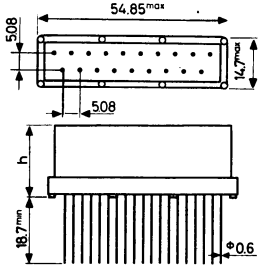
The 1-Series is composed of the following circuit blocks and assembled panels.

description	*abbreviation*	*colour*	*basic circuit*	*function*	*catalog number*
Circuit blocks					
Dual gate inverter	2.GI1	yellow	two gate inverting amplifiers	dual NAND or dual NOR, set/reset flip-flop, non-inverting amplifier, relay driver; furthermore it can be preceded by one or two level logic	2722 001 08001
Flip-flop	FF3 FF4	red	bi-stable multivibrator	memory, binary scaler-of-two memory, shift register	2722 001 00021 2722 001 00031
Dual negative gate	2.3N1 2.2N1	orange	two identical three-input diode gates two identical two-input diode gates	in conjunction with 2.GI1 two- or three-stage logic levels can be formed	2722 001 01001 2722 001 01011
Dual pulse logic	2.PL2	orange	two identical pulse gates	in conjunction with FF3 or FF4 a bi-directional shift register or a bi-directional counter can be formed	2722 001 03011

Pulse shaper	PS2	green	Schmitt trigger followed by an inverting amplifier	converting non-standard signals into standard signals	2722 001 11011
Positive reset unit	PR1	blue	non-inverting amplifier	resetting of max 40 flip-flops FF3 or FF4	2722 001 22001
One-shot multivibrator	OS2	green	monostable multivibrator	generating positive and negative pulses with adjustable duration (max. 1 ms)	2722 001 10011
Pulse driver	PD1	green	monostable multivibrator with built-in trigger gate	generating pulses for triggering and resetting flip-flops FF3 or FF4	2722 001 13011
Printed-wiring board	PDA1			for mounting up to four units PD1	4322 026 34710
Power amplifier	PA1		non-inverting high-power amplifier	max. output: 60 V, 600 mA	2722 032 00011
Printed-wiring board	PAA1			for mounting up to four units PA1	4322 026 33630
Assembled panels					
Dual decade counter	2.DCA2		2 x four flip-flops FF3, mounted on a printed-wiring board	decade counter (1-2-4-8 code)	2722 009 00011
Reversible counter	BCA1		five flip-flops FF4 and five dual pulse logics 2.PL2, mounted on a printed-wiring board	bi-directional shift register, bi-directional decade counter	2722 009 00021

CIRCUIT BLOCKS

description	*abbreviation*	*colour*	*basic circuit*	*function*	*catalog number*
Dual numerical indicator tube driver assembly	2.ID1		two decoding and driving circuits for numerical indicator tubes (ZM1000, ZM1020, ZM1040 or ZM1080) mounted on a printed-wiring board	operating in conjunction with decade counters (1-2-4-8 or 1-2-4-2 code) for numerical display	2722 009 05001
Decade counter and numerical indicator tube driver assembly	DCA3		four flip-flops FF3 with a decoding and driving circuit ID1, mounted on a printed-wiring board	decade counter (1-2-4-8 code) with ID1 for numerical display	2722 009 00031



Circuit blocks 10-Series

Maximum pulse repetition frequency = 30 kHz, for triggered logic applications.
Supply: $V_P = +12\ V \pm 5\%$, $V_N = -12\ V \pm 5\%$
Ambient temperature range: -25 to $+55°C$
Logic levels:
binary "1": $\frac{2}{3}\ V_P$ to V_P
binary "0": 0 to 0.3 V

The 10-Series is composed of the following circuit blocks and assembled panels.

h = max. 27.0 mm for high case
= max. 19.5 mm for low case

description	*abbreviation*	*case*	*basic circuit*	*function*	*catalog number*
Circuit blocks					
Dual positive gate inverter amplifier	2.GI10	low	two gate inverting amplifiers	dual NAND with four inputs in total	2722 004 08001
	2.GI11	high		dual NAND with six inputs in total	2722 004 08011
	2.GI12	high		dual NAND with eight inputs in total	2722 004 08021
Flip-flop	FF10	low	bi-stable multivibrator	memory, one stage of a binary counter or shift register, one stage of a bi-directional counter or bi-directional shift register	2722 004 00001
	FF11	high	bi-stable multivibrator with built-in trigger gates	memory, binary divider, two stages of a bi-directional counter or bi-directional shift register	2722 004 00011
	FF12	high	bi-stable multivibrator with built-in trigger gates and set/reset inputs	as FF11	2722 004 00021
Dual trigger gate	2.TG13	low	two pulse gate circuits	one stage of a bi-directional counter or bi-directional shift register in conjunction with FF11 or FF12, one stage of a binary counter or shift register in conjunction with FF10	2722 004 15001
	2.TG14	low	as 2.TG13 but with two separate built-in diodes for extension of the number of gate inputs	as 2.TG13	2722 004 15011

description	*abbreviation*	*case*	*basic circuit*	*function*	*catalog number*
Quadruple trigger gate	4.TG15	high	four pulse gate circuits	two stages of a bi-directional counter or bi-directional shift register in conjunction with FF11 or FF12, one stage of a bi-directional counter or bi-directional shift register in conjunction with FF10	2722 004 15021
Timer unit	TU10	high	Schmitt trigger followed by an inverting amplifier, with built-in trigger gate	delay function; max. delay is 60 s	2722 004 18001
Gate amplifier	GA11	low	gate circuit followed by a non-inverting amplifier	AND-, AND-AND-, AND-OR, preceded by one-level or two-level logic circuits	2722 004 17001
One-shot multivibrator	OS11	high	monostable multivibrator with built-in trigger gate	generating positive and negative pulses with adjustable duration	2722 004 10011
Pulse driver	PD11	high	monostable multivibrator with built-in trigger gate	generating pulses for triggering and resetting flip-flops FF10, FF11 or FF12	2722 004 13011
Pulse shaper	PS10	low	Schmitt trigger followed by an inverting amplifier	converting non-standard signals into standard signals	2722 004 11001

Relay driver	RD10	low	non-inverting medium power amplifier	driving relays; output: 55 V, 200 mA (resistive loads) 30 V, 200 mA (inductive loads)	2722 004 16001
	RD11	low		driving relays; output: 55 V, 200 mA	2722 004 16011
Power amplifier	PA10		high-power amplifier	output: 55 V/2 A	2722 032 00021
Printed-wiring board	PAA10			for mounting up to four units PA10	4322 026 38680
Numerical indicator tube driver	ID10	high	decoding and driving circuit for numerical indicator tubes (ZM1000, ZM1020, ZM1040 or ZM1080)	operating in conjunction with decade counters (1-2-4-8 or 1-2-4-2 code) for numerical display	2722 004 20001
Assembled panels					
Decade counter and numerical indicator tube driver assembly	DCA10		four flip-flops FF12 with or without ID10, mounted on a printed-wiring board	DCA 10A: single decade counter with ID10	2722 009 02001
				DCA 10B: as DCA 10A, but without ID10	2722 009 02011
				DCA 10C: buffer memory with ID10	2722 009 02021
				DCA 10D: as DCA 10C, but without ID10	2722 009 02031
				DCA 10E: binary counter, scaler of 16	2722 009 02041
Dual decade counter and numerical indicator tube driver assembly	2.DCA11		2× four flip-flops FF12, with or without ID10, mounted on a printed-wiring board	2.DCA 11A: dual decade counter with ID10	2722 009 02051
				2.DCA 11B: as 2.DCA 11A, but without ID10	2722 009 02061

CIRCUIT BLOCKS

description	*abbreviation*	*case*	*basic circuit*	*function*	*catalog number*
Dual decade counter assembly	2.DCA12		2 × four flip-flops FF12, mounted on a printed-wiring board	2.DCA 12A : dual decade counter 2.DCA 12B : decade counter and buffer memory 2.DCA 12C : binary counter, scaler of 16, binary scaler of 256	2722 009 02071 2722 009 02081 2722 009 02091
Reversible decade counter and numerical indicator tube driver assembly	BCA10		four flip-flops FF12, two quadruple trigger gates 4.TG15, with or without 2.GI10 and/or ID10, mounted on a printed-wiring board	BCA 10A : reversible decade counter (1-2-4-8 code) with ID10 BCA 10B : as BCA 10A, but without ID10 BCA 10C : reversible decade counter (forward 1-2-4-8 code, reverse 1-2-4-2 code) without 2.GI10 and with ID10 BCA 10D : as BCA 10C, but without ID10	2722 009 02101 2722 009 02111 2722 009 02121 2722 009 02131
Dual shift register assembly	2.SRA10		2 × five flip-flops FF12, mounted on a printed-wiring board	dual 5-stages one-directional shift register, dual one-directional decade ring counter, single 10-stages one-directional shift register	2722 009 03001

Reversible shift register assembly	RSR10	five flip-flops FF12, one dual trigger gate 2.TG13 and two quadruple trigger gates 4.TG15	5-stages reversible shift register, reversible decade ring counter, one-directional shift register with additional inputs for parallel information shift	2722 009 03011

Circuit blocks 40-series and CSA 70

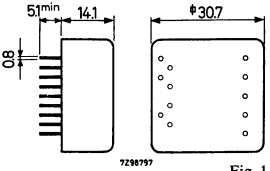


Fig. 1

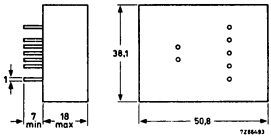


Fig. 3

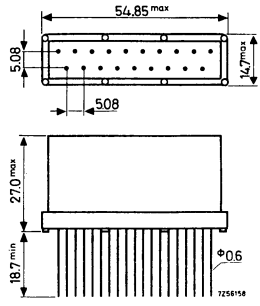


Fig. 2

The 40-Series is composed of the following circuit blocks:

DOA40 (Fig. 2), supply: $V_P = +15V \pm 3\%$, $V_N = -15V \pm 3\%$
DOA42 (Fig. 1), supply: $V_P = +15\ V \pm 3\%$, $V_N = -15\ V \pm 3\%$
DZD40 (Fig. 2), supply: $V_P = +12\ V \pm 5\%$, $V_N = -12\ V \pm 5\%$
PSM40 (Fig. 2), supply: $V_P = +12\ V \pm 5\%$, $V_N = -12\ V \pm 5\%$
CSA70 (Fig. 3), supply: $V_P = +15\ V \pm 3\%$, $V_N = -15\ V \pm 3\%$

description	*abbreviation*	*basic circuit*	*application*	*catalog number*
Operational amplifier Temperature range 0 to 85°C	DOA40	high gain, wide band, low drift d.c. differential amplifier	instrumentation and control circuits	2722 010 01011
Differential amplifier Temperature range −25 to +85°C	DOA42	high gain d.c. differential amplifier with low input bias current	instrumentation and control circuits	9331 019 30112

Differential zero detector Temperature range 0 to 70°C	DZD40	2-stage d.c. coupled differential amplifier followed by an OR-gate and an inverting amplifier	for use as zero detector, voltage comparator, polarity detector, adjustable discriminator, differential amplifier	2722 010 00001
Phase shift module Temperature range −25 to +85°C	PSM40	units produces line zero synchronized output pulses of which leading edge can be shifted by a control voltage	for use in conjunction with a trigger source for the control of the conduction angle of thyristors	2722 010 02001
Operational amplifier Temperature range 0 to +60°C	CSA70	high d.c. stability, the d.c. and low-frequency signals are chopped	high current and voltage stability therefore small d.c. and low-frequency signals receive accurate amplified reproduction	2722 011 00001

Counter modules 50-Series

Maximum counting rate
- uni-directional : 50 kHz
- bi-directional : 12 kHz

Supply
- indicator tubes : +250 V ± 18%
- logic circuits : + 24 V ± 10%

} see "Power supplies", section "ACCESSORIES FOR CIRCUIT BLOCKS".

Ambient temperature range: −25 to +70°C

The 50-series is composed of the following modules.

CIRCUIT BLOCKS

description	*abbreviation*	*case*	*basic circuit*	*function*	*catalog number*
Numerical indicator counter	NIC50	Fig. 1	uni-directional decade counter coupled to a numerical indicator tube ZM1000	preset programmed control systems	2722 007 03001
Reversible indicator counter	RIC50	Fig. 1	bi-directional decade counter coupled to a numerical indicator tube ZM1000	preset programmed control systems	2722 007 04001
Memory indicator driver	MID50	Fig. 1	buffer memory coupled to a numerical indicator tube ZM1000	storage of information from NIC50 or RIC50	2722 007 05001
Sign indicator driver	SID50	Fig. 1	indicator tube ZM1001 with driving circuit for plus and minus characters	plus and minus character indicator; characters ~, X, Y and Z are accessible	2722 007 06001
Triple NOR gate	3.NOR50	Fig. 2	6 input buffer NOR and dual 4 input NOR	buffer NOR for adapting the output levels of NIC50 and RIC50 to standard logic levels; 4 input NOR for logic purposes (e.g. memory function)	2722 007 00001
Quadruple NOR gate	4.NOR51	Fig. 2	quadruple 4 input NOR	logic purposes (e.g. memory function)	2722 007 00011

Pulse shaper and reset unit	PSR50	Fig. 2	pulse shaper: Schmitt trigger followed by an inverting amplifier; reset unit: monostable multivibrator	pulse shaper: converting input signals into counting pulses for NIC50 and RIC50; reset unit: generating pulses for resetting NIC50 and RIC50, generating pulses for resetting memories formed by cross-connected 4 input NOR's, generating transfer pulses for MID50	2722 007 01001
Lamp/relay driver	LRD50	Fig. 2	inverting low-power amplifier preceded by a 3 input OR-gate	driving lamps and relays	2722 007 02001

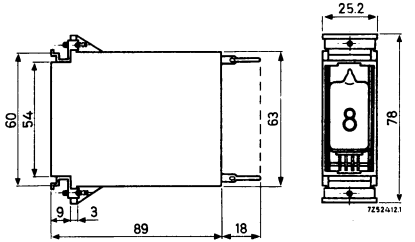


Fig. 1

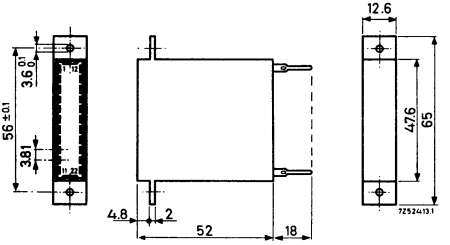


Fig. 2

CIRCUIT BLOCKS

description	*abbreviation*	*case*	*basic circuit*	*function*	*catalog number*
Printer drive units	PDU50A	Fig. 2	ten separate inverting stages	driving decimal input printers	2722 007 08001
	PDU50B	Fig. 2	scanning circuit		2722 007 08011
Decade counter and divider	DCD50	Fig. 2	four flip-flops	divider of 2, 3, 4, 5, 6, 8, 9, 10, 12 and 16	2722 007 07001
10 position thumbwheel switch	SU50	see "Thumbwheel switches", section "INPUT/OUTPUT DEVICES"			

For non-standard circuit configurations the empty case assembly ECA50 (catalog number 2722 007 89001) comprising a plastic case, a general purpose printed-wiring board and a rear bar is available.

60-Series NORBITS

These circuit blocks represent an important advance in static switching devices for industrial control systems. They use NOR logic as a basis of operation (positive logic).

Supply: $V_S = +24\ V \pm 25\%$ or
$+12\ V \pm 5\%$ at reduced ratings

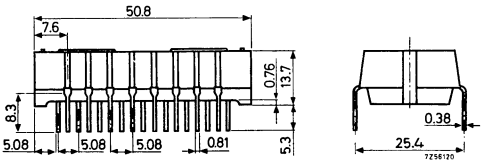
Ambient temperature range: -10 to $+70°C$

Logic levels:

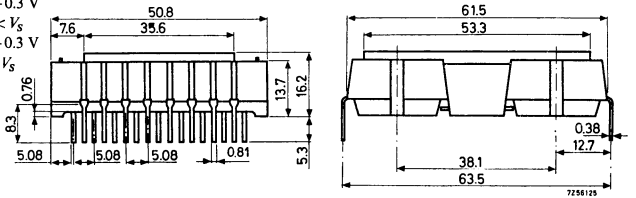
at $V_S = 24\ V \pm 25\%$: $0\ V <$ binary "0" $< +0.3\ V$
$11.4\ V <$ binary "1" $< V_S$

at $V_S = 12\ V \pm 5\%$: $0\ V <$ binary "0" $< +0.3\ V$
$8.3\ V <$ binary "1" $< V_S$

The 60-Series NORBITS is composed of the following circuit blocks.



Size A



Size B

description	*type*	*case*	*colour*	*basic circuit and function*	*catalog number*
Dual four input NOR gate	2.NOR60	size A	black	two identical NOR-circuits, each with four inputs	2722 008 00001
Quadruple $2 \times 2 + 2 \times 3$ input NOR gate	4.NOR60	size A	black	two identical 2-input and two identical 3-input NOR circuits	2722 008 00011
Dual inverter amplifier	2.IA60	size A	blue	two identical inverting amplifiers or single inverting low power amplifier by connecting two units in tandem	2722 008 01001

CIRCUIT BLOCKS

description	*type*	*case*	*colour*	*basic circuit and function*	*catalog number*
Dual low power amplifier	2.LPA60	size A	blue	two identical inverting low power amplifiers	2722 032 00041
Grounded load driver	GLD60	size A	black	2-input power amplifier for switching d.c. loads connected with one side to ground 2-input NOR gate	2722 008 06001
Timer unit	TU60	size A	red	time delay circuit: following a "0" going input the output is a delayed "1"; no delay occurs when input returns to "1" (output goes "0" immediately)	2722 008 03001
Dual input switch filter	2.SF60	size A	green	two identical filters for eliminating the effects of contact bounce of mechanical switches and interference on input lines of same	2722 008 02001
Power amplifier	PA60	size B	blue	Schmitt trigger, buffer and driver stage and power amplifier for load switching	2722 032 00031
High power amplifier	HPA60	size B	black	Schmitt trigger, buffer + drive stage, and power amplifier for load switching	2722 032 00101
Accessories for 60-series Norbits: (See also Accessories for circuits blocks and electr.-mech. components)					
Thyristor trigger transformer	TT60	34 × 34 moulded	brown	It can produce, in conjunction with PA60, two pulse currents of up to 400 mA	2722 032 00051
Plastic mounting chassis	UMC60	245 × 95 × 28		Mounting facility for 6 size A or 3 size B blocks or combination	4322 026 38330

Printed-wiring board for use in UMC60	PWB63	183 x 89	Tracks are such that only short jumpers need be used to obtain all kinds of logic functions	4322 026 73750
Breadboard block	BB60	38 x 56 x 14	For easy realization of instructive circuits with one BB60 for each size A block	9390 198 00002

CIRCUITS BLOCKS

61-Series NORBITS

Extension to the NORBIT range in order to facilitate using NORBITS in thyristorized power control circuits.
Encapsulation: size A block like 60-series units; colour: black.
The 61-series comprises the following types:

description	*type*	*basic circuit and function*	*catalog number*
Dual 2-input NOR-gate with diode resistor networks	2NOR61	two two-input transistor-resistor NOR gates and diode gating facilities specifically applicable as a d.c. counting/shifting stage	2722 008 00021
Rectifier and synchronization assembly	RSA61	rectifier circuits to provide (a) an unregulated voltage of +24 V, (b) synchronization signals, (C) +12 V and −12 V (zener stabilized) for servo amplifiers	2722 008 05001
Universal power amplifier	UPA61	three independent circuits to provide (a) d.c. switching amplifier, (b) power oscillator for driving thyristor trigger transformers, (c) phase shift module and (d) current source for linear capacitor discharging	2722 032 00071
Dual trigger transformers	TT61	two identical trigger transformers to match the pulse output from a power amplifier (e.g. UPA61) to thyristor gates	2722 032 00081
Differential amplifier	DOA61	amplification 10x/100x, loop shaping and comparison with reference signals in analogue closed-loop systems	2722 008 04001
Accessories 61-Series Norbits: (See also Accessories for circuit blocks and electr.-mech. components)			
Direct current transformer	DCT61	It provides, in conjunction with UPA61 or GLD60, the linear conversion of high d.c. current to a low d.c. voltage	9360 000 40000

Circuit blocks 90-series

Circuit blocks in size A encapsulation, operating with trigger logic but partly compatible with 60-series, intended for use in counters and shift registers of industrial control systems.

description	*type*	*basic circuit and function*	*catalog number*
Flip-flop	FF90	set-reset bistable multivibrator with trigger gates; input 1–0 edge of 3 μs max.	2713 001 00001
Twin trigger tube	2.TG90	two extra independent trigger gates for the EF90	2713 001 00002
Pulse shaper	PS90	Schmitt trigger circuit followed by an inverting amplifier for (a) driving the trigger inputs of one or more EF90 or 2. TG90 units or (b) shaping signals to produce NORBIT60 drive levels	2713 001 00003

ACCESSORIES FOR CIRCUIT BLOCKS

Power supplies

The following power supply units and sub-assemblies for power supplies are available: Power supply units for digital circuit blocks

application	*fits 19" chassis*	*dimensions (mm)*	*input*	*d.c. output*	*stability ratio*	*catalog number*
1 Series circuit blocks	4322 026 38240	215 × 125 × 70	220 V 235 V 50–60 Hz	−6 V, 600 mA +6 V, 150 mA	450 : 1 360 : 1	2722 151 00011
10-Series circuit blocks	4322 026 38240	214 × 123 × 91	105–120 V 200–240 V 45–65 Hz	−12 V, 400 mA +12 V, 1000 mA	350 : 1 1000 : 1	2722 151 00021
Counter modules 50-Series		170 × 140 × 87	110, 120, 130, 220, 230, 240 V 45–65 Hz	+24 V ± 5%, 0–250 mA for logic supply; +250 V ± 18%, max. 40 mA for numerical indicator tube supply		2722 151 00061
60-Series NORBITS		146 × 76 × 77	240, 230, 220, 120 or 100 V 47–440 Hz	+30 to +18 V for 0 to 500 mA		2722 151 00041 type PSU60
60-Series NORBITS		146 × 76 × 77	240, 230, 220, 120 or 100 V 47–440 Hz	+30 to +18 V for 0 to 500 mA, and +100 V, 25 mA		2722 151 00051 type PSU61
60-Series NORBITS	fits in UMC60	90 × 83	220 V (110 V)	+30 to +18 V for 0–150 mA		4322 000 01000 (4322 000 01010) type LSU60

Sub-assemblies for power supplies

Type MF0.5A : Mains filter for use between <250 V mains and mains input of control systems consuming less than 0.5 $A_{a.c.}$
Attenuation 0.1–10 MHz: 50 dB.
Dimensions : 88 × 47 × 39 mm.

Type MF2A : Mains filter for use between <250 V mains and mains input of control systems consuming less than 2$A_{a.c.}$
Attenuation 0.3–15 MHz: 50 dB
Dimensions : 153 × 47 × 39 mm.

Locking aids

(to secure circuit blocks to the p.w. board)

Locking tag for the 1-series	4322 026 33690
Locking cap for the 10-series and the 20-series	4322 026 32150
Soldering tag for locking cap	4322 026 32140

Stickers

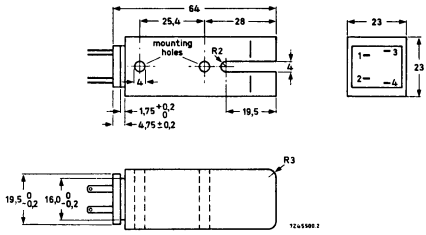
These are drawing symbols of circuit blocks printed on self-adhesive, transparent material. They can be used for fast preparation of system drawings.
Stickers for circuit blocks of the 1-, 10- and 20-Series are available in rolls of 1000 pieces; stickers for circuit blocks of the 40-Series of counter modules 50-Series, and 60- and 61-Series Norbits are available in sheets.

Printed-wiring boards: (see ELECTRO-MECHANICAL COMPONENTS)

INPUT/OUTPUT DEVICES

Vane switched oscillator VSO

Catalog number 2722 031 00001



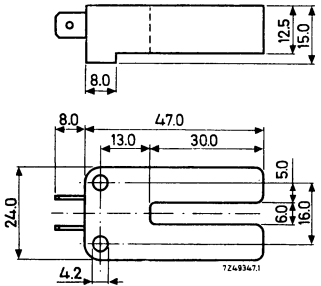
Application: This unit can be applied as a static switching device, the switching action being determined by the position of a vane. For the vane any metal can be used.

Technical performance

Vane material	any metal
Supply, terminals 2–1	12 $V_{d.c.}$, 12 mA
Output voltage, terminals 3–4	5.75 V ± 15% open circuit, isolated
Maximum permissible voltage between 1–2 and 3–4	100 V_p
Output impedance (without vane)	4.1 kΩ ± 10%
Maximum detection frequency	1 kHz
Operating temperature range	−25 to +85°C

Iron vane switched reed IVSR

Catalog number 2722 031 00011

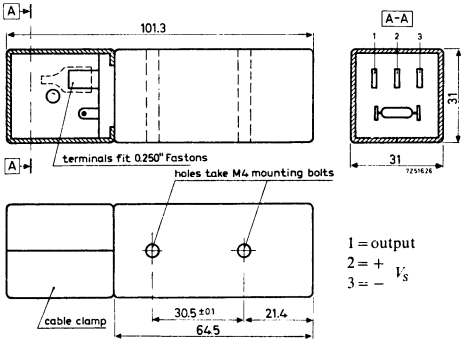


Application: It can be applied as a limit switch, position indicator or as a signal source for low counting speeds. In conjunction with a d.c. amplifier or with the TTM it can be used for power switching. It can succesfully replace micro switches.

Technical performance

Vane material	mild steel
Load switching capacity (non inductive)	≤1.2 VA
Voltage switching capacity	≤32 $V_{d.c.}$ ≤50 $V_{a.c.}$
Current switching capacity (non inductive)	≤0.1 $A_{d.c.}$
Switching frequency	≤100 Hz
Operating temperature range	−25 to +70°C

Electronic proximity detector EPD



Catalog number 2722 031 00021

Application: The electronic proximity detector is a static switching device, the switching action being determined by the presence of a metallic object. The metal can be any electrically conducting material of rather arbitrary shape.

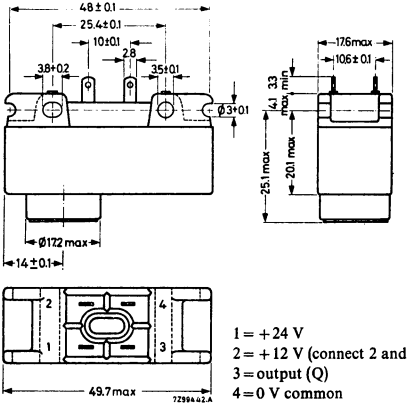
It can be applied as a detector for the presence, passage or position of metal parts and is a versatile tool in various industrial automation set-ups.

Technical performance

Supply voltage (V_S)	12 $V_{d.c.}$
Consumed current	16 mA
Output voltage, no object being detected	approximately $V_S - 0.5$ V
Output resistance	
no object being detected	680 Ω ± 10 %
object being detected	3.3 kΩ
Minimum load	1 kΩ
Maximum detection frequency	1 kHz
Operating temperature range	−25 to +85 °C

INPUT/OUTPUT DEVICES

Miniature electronic proximity detector EPD60



1 = +24 V
2 = +12 V (connect 2 and 1)
3 = output (Q)
4 = 0 V common

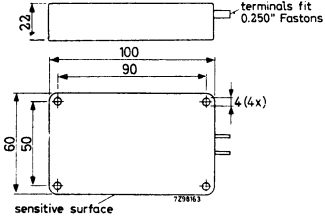
Catalog number 2722 031 00091

Application: It can be applied as a static switching device, the switching action being determined by the position of a metal object. In this way a static equivalent for the well-known mechanical miniature switch is obtained.

Technical performance

Supply voltage (V_s)	+24 V ±25% or +12 V ±5%
Consumed current (nominal)	15 mA
Output voltage	
no object being detected	max. 0.3 V
object being detected	min. +11.4 V at V_s = +24 V min. +8.3 V at V_s = +12 V
Output resistance	
no object being detected	3 kΩ
object being detected	15 kΩ
Maximum detection frequency	1 kHz
Operating temperature range	−25 to +70°C
Detection range	3 mm

Magnetic proximity detector MPD



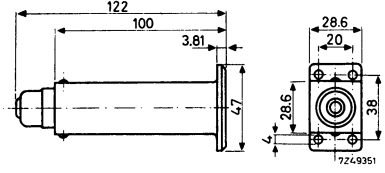
Catalog number 2722 031 00031

Application: This unit can be applied as a detector for the presence, passage or position of ferreous parts. It is a versatile tool in industrial automation set-ups.

Technical performance

Load switching capacity	$\leqslant 25$ W
Voltage switching capacity	$\leqslant 200$ $V_{d.c.}$
Current switching capacity	$\leqslant 1$ $A_{d.c.}$
Switching frequency	$\leqslant 100$ Hz
Contact resistance, initially	$\leqslant 100$ mΩ
Operating temperature range	-25 to $+70$°C

Photo-electric detector CSPD



Catalog number 2722 031 00041

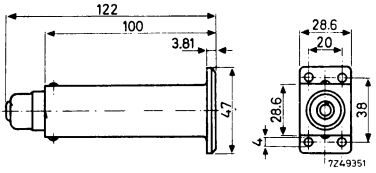
Application: Input device in digital systems. To be used in conjunction with lamp unit 1MLU.

Technical performance

Type of detector	cadmiumsulfide
Max. voltage	150 V_p
Max. dissipation at 40°C	0.2 W
Max. switching frequency	6 Hz
Max. operating distance (with 1 MLU)	1 m
Operating temperature range	-10 to $+40$°C

Lamp unit 1 MLU

Catalog number 2722 031 00051

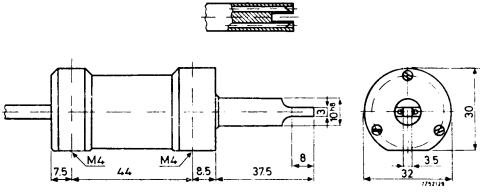


Application: To be used in conjunction with photo-electric detector CSPD

Technical performance

Supply voltage	$\leqslant 6\ V_{a.c.}$ or $6\ V_{d.c.}$
Max. operating distance (with CSPD)	1 m
Operating temperature range	−10 to +40°C

Light interruption probe LIP1



Catalog number 2722 031 00081

Application: The light interruption probe can be used for the detection of the presence or passage of small objects. Major applications are envisaged in the field of accurate positioning and revolution counting.

Connections: The unit is provided with a 4-core colour coded shielded cable with a length of 2 m:
White lead to +12 V
Yellow lead to +12 V via a resistor (supplied with the unit)
Brown lead common 0 V
Green lead to load

Technical performance

Output, unloaded	
no object	0 to +1.25 V
with object	+4.8 to+12 V
Output impedance	
no object	max. 2.1 kΩ
complete interception	max. 1.1 kΩ
Max. detection frequency	>10 kHz
Operating temperature range	0 to +50°C

Catalog number 4311 027 82 . . . .

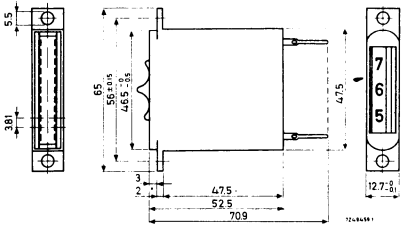


Fig. 1: Switch for façade mounting

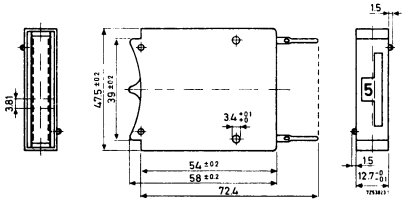


Fig. 2: Switch for block mounting

Application: These switches have been developed to be used as pre-set devices in digital control systems, in which numerical information is handled. Two versions are available, one for façade mounting and one for block mounting.

Technical performance

Working voltage	50 $V_{d.c.}$
Insulation resistance	$\geqslant 10^8\ \Omega$
Current switching capacity in purely resistive circuits	0.1 $A_{d.c.}$
Maximum current carrying capacity	0.5 $A_{d.c.}$
Contact resistance	$\leqslant 50\ m\Omega$
Losses (tan δ), measured at 1 MHz	$\leqslant 25.10^{-4}$
Capacitance, measured at 1 MHz	$\leqslant 15$ pF
Life	in excess of 100000 complete rotations, at a rate of 1 step/s
Operating torque	250 to 750 gcm
after 20000 rotations	150 to 650 gcm
Printed-wiring boards	glass-epoxy; goldplated tracks
Operating temperature range	-25 to $+85$°C

INPUT/OUTPUT DEVICES

Façade mounting

The switches can be mounted in panels with a thickness up to 4 mm by means of mounting façades The following mounting façades are available

mounting façade	*number of switches*	*catalog number*
FMF1	1	4311 027 80598
FMF2	2	4311 027 80608
FMF3	3	4311 027 80618
FMF4	4	4311 027 80628
FMF5	5	4311 027 80638
FMF6	6	4311 027 80648
FMF7	7	4311 027 81163
FMF8	8	4311 027 81173
FMF9	9	4311 027 81183
FMF10	10	4311 027 81193

Block mounting

These switches which do not require a front façade can be "block mounted" by means of mounting brackets and 3 mm tie rods. Maximum allowable couple applied to the nuts to clamp the switches to each other is 750 gcm. Accessories include:

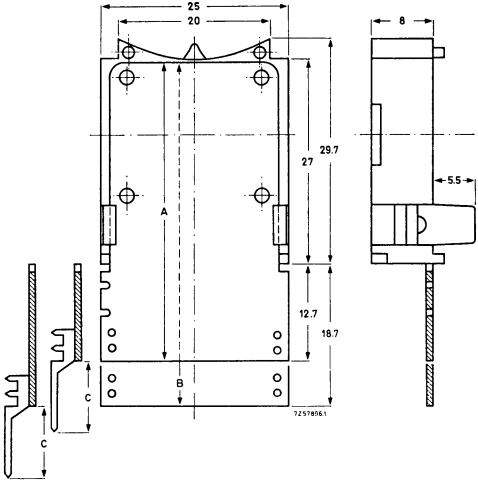
End piece (cat. no. 4311 027 82151)
Spacer (cat. no. 4311 027 82161)
Blank housing (cat. no. 4311 027 82141)
Blank housing with decimal point (cat. no. 4311 027 83491)

	description[1])	*type*	*figures or signs*[2])	*catalog number* 4311 027	
				façade mounting	*block mounting*
decimal and 2 position switches	10 position 2 pole switch	10P2C	0–9	82201	82521
	10 position 1 pole switch	10P1C	0–9	82321	82401
	2 position 4 pole sign switch	2P4+ −	+, −	82231	82641
	2 position 2 pole sign switch	2P2+ −	+, −	82341	82601
	2 position 4 pole sign switch	2P4× ÷	×, ÷	82311	82651
	2 position 2 pole sign switch	2P2× ÷	×, ÷	82351	82611
binary decoding switches (including 4 diodes BAX13 and a resistor of 12 kΩ)	decoding switch 1248 negative logic	1248N	0–9	82221	82391
	decoding switch 1248 positive logic	1248P	0–9	82251	82411
	decoding switch 1242 (jump at 8) negative logic (Berkeley code)	1242N	0–9	82211	82711
	decoding switch 1242 (jump at 8) positive logic (Berkeley code)	1242P	0–9	82241	82721
	decoding switch 1248 negative logic[3])	1248N/C	0–9	82451	82541
	decoding switch 1248 positive logic[3])	1248P/C	0–9	82431	82551
	decoding switch 1242 (jump at 8) negative logic[3])	1242N/C	0–9	82441	82571
	decoding switch 1242 (jump at 8) positive logic[3])	1242P/C	0–9	82421	82581
binary coding switches	coding switch 1248	1248C	0–9	82271	82531
	coding switch 1242 (jump at 8)	1242C	0–9	82261	82701
	coding switch 1248[4])	1248C/C	0–9	82471	82561
	coding switch 1242 (jump at 8)[4])	1242C/C	0–9	82461	82591
	coding switch 1248	1248S	0–9		82511

[1]) The contacts of all switches break before make. [2])Other possibilities on request. [3]) Switch decodes 9-complement of decimal digit on thumbwheel. [4]) Switch encodes 9-complement of decimal digit on thumbwheel.

INPUT/OUTPUT DEVICES

Miniature thumbwheel switches



A: short track plate without diodes
B: long track plate with diodes and for 10P2C
C: 10 mm added to the height for mini-wrap pins

Catalog number 4311 027 84...

Application: These switches have been developed for use as preset devices in digital systems which have to handle numerical data.

Technical performance

Working voltage	60 $V_{d.c.}$
Insulation resistance	$>10^9\ \Omega$
Current switching capacity in purely resistive circuits	0.1 $A_{d.c.}$
Maximum current carrying capacity	2 $A_{d.c.}$
Contact resistance	$< 100\ m\Omega$
Capacitance measured at 1 MHz	< 10 pF
Standard gate resistor	$3900\ \Omega$
Life	in excess of 100000 complete rotations at a rate of 1 step/s
Operating torque	100 to 200 gcm
Printed-wiring board	glass epoxy; goldplated tracks on nickel
Operating temperature range	$-25°C$ to $+70°C$

Mounting accessories

set of two end pieces with bolts	cat. no. 4311 027 84440
set of two end pieces with brackets	4311 027 88801
spacer	84590
spacer with decimal point	84910

description[1])	*type*[2])	*catalog number*
Decimal switches		
10 position 1 pole switch	M 10P1C	4311 027 84000
	MW 10P1C	84010
10 position 2 pole switch	M 10P2C	84040
+, − switch	M 5 × 2P1C	84940
	MW 5 × 2P1C	84950
Double +, − switch	M 5 × 2P2C	84920
	MW 5 × 2P2C	84930
Binary switches		
Decoding types:		
decoding switch 1.2.4.8, negative logic, with complement	M 1248/NC	4311 027 84200
	MW 1248/NC	84210
decoding switch 1.2.4.8, positive logic, with complement	M 1248/PC	84240
	MW 1248/PC	84250
Coding types:		
coding switch 1.2.4.8	MW 1248	84170
coding switch 1.2.4.8, with complement	M 1248/C	84160
	MW 1248/C	84290
Encoding types:		
encoding switch 1.2.4.8, with isolating diodes for negative logic	M 1248/N	84080
	MW 1248/N	84090
encoding switch 1.2.4.8, with isolating diodes for positive logic	M 1248/P	84120
	MW 1248/P	84130

Note: The contacts of all switches break before make.

[1]) Switches can be obtained with figures or signs engraved as ordered by customer

[2]) Terminal style: M = without pins (solder direct to track plate)
MW = with pins (for wire wrapping)

POWER STACKS WITH DIODES AND/OR THYRISTORS

General

For bridges the rated currents are max. values of the direct current which can be permitted to flow continuously, the conduction angle of the semiconductors being 180° (single phase) or 120° (three phase).
For a.c. controllers the rated currents are maximum r.m.s. values of the line current which can be permitted to flow continuously, the conduction angle of the semiconductors 180°.
The rated current values are based on thermal design consideration, they do not apply to capacitive loads.

$I_{35°C}$: rated current at 35°C ambient temperature with natural convection cooling
$I_{45°C}$: rated current at 45°C ambient temperature with natural convection cooling
$I_{5m/s}$: rated current at 35°C ambient temperature with forced air cooling, air velocity 5m/s (1000 ft/min).

V_{rat}: *max. recommended nominal a.c. voltage*

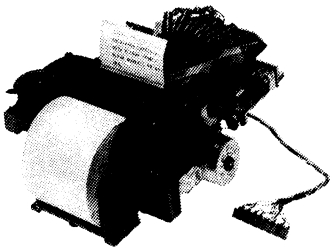
Type number	V_{rat} (*V*)	$I_{5m\,s}$ (*A*)	$I_{35°C}$ (*A*)	$I_{45°C}$ (*A*)	*width* × *height* × *depth* (*mm* × *mm* × *mm*)	*cat. number*
Single phase diode bridges						
P1 RB20/300	300	—	20	20	180 × 164 × 183	9331 435 30112
P1 RB40/270	270	—	40	40	309 × 164 × 183	9331 435 40112
P1 RB80/300	300	—	80	74	309 × 164 × 183	9331 435 50112
P1 RB185/270	270	—	185	175	309 × 283 × 183	9331 435 60112
P1 RB410/270	270	640	410	380	309 × 283 × 366	9331 435 70112
Three phase diode bridges						
P3 RB25/400	400	—	25.5	25.5	180 × 164 × 183	9331 437 30112
P3 RB46/400	400	—	46	46	309 × 164 × 183	9331 437 40112
P3 RB110/400	400	—	110	105	309 × 283 × (183 + 25)	9331 437 50112
P3 RB210/400	400	300	210	198	309 × 283 × (183 + 25)	9331 437 60112
P3 RB380/400	400	720	380	350	438 × 283 × 183	9331 437 70112
P3 RB546/400	400	870	546	510	438 × 283 × 366	9331 437 80112
Single phase half-control bridges						
P1 HCB18/230	230	—	18.2	16.4	180 × 164 × 183	9331 435 80112
P1 HCB37/230	230	—	37.5	34	309 × 164 × 183	9331 435 90112
P1 HCB51/230	230	—	51	50	309 × 283 × (183 + 25)	9331 436 00112
P1 HCB125/230	230	—	125	114	438 × 283 × 183	9331 436 10112
P1 HCB238/270	270	400	238	206	438 × 283 × 183	9331 436 20112
Three phase half-control bridges						
P3 HCB20/400	400	—	20	17.4	180 × 164 × 183	9331 437 90112
P3 HCB40/400	400	—	40	37.5	309 × 283 × (183 + 25)	9331 438 00112
P3 HCB100/400	400	—	100	90	309 × 283 × (183 + 25)	9331 438 10112
P3 HCB165/400	400	—	165	150	537 × 283 × 183	9331 438 20112
P3 HCB282/400	400	550	282	260	537 × 283 × 183	9331 438 30112

POWER STACKS WITH DIODES AND/OR THYRISTORS

Type number	V_{rat} (*V*)	$I_{5m/s}$ (*A*)	$I_{35°C}$ (*A*)	$I_{45°C}$ (*A*)	*width* × *height* × *depth* (*mm* × *mm* × *mm*)	*cat. number*
Single phase full-control bridges						
P1 FCB12/230	230	—	12.8	12.8	309 × 164 × 183	9331 436 30112
P1 FCB37/230	230	—	37.5	34	309 × 164 × 183	9331 436 40112
P1 FCB51/230	230	—	51	50	309 × 283 × (183 + 25)	9331 436 50112
P1 FCB125/230	230	—	125	114	309 × 283 × (366 + 50)	9331 436 60112
P1 FCB238/270	270	400	238	206	309 × 283 × (366 + 50)	9331 436 70112
Three phase full-control bridges						
P3 FCB15/330	330	—	15	15	180 × 283 × 183	9331 438 40112
P3 FCB31/400	400	—	31	28	438 × 164 × 183	9331 438 50112
P3 FCB40/400	400	—	40	37	438 × 164 × 183	9331 438 60112
P3 FCB81/400	400	—	81	72	438 × 164 × 183	9331 438 70112
P3 FCB165/400	400	—	165	150	438 × 283 × 366	9331 438 80112
P3 FCB327/400	400	550	327	288	438 × 283 × 366	9331 438 90112
Single phase a.c. controllers						
P1 ACC14/230	230	—	14	14	180 × 164 × 183	9331 436 80112
P1 ACC32/230	330	—	32	29	180 × 164 × 183	9331 436 90112
P1 ACC57/230	230	—	57	57	309 × 164 × 183	9331 437 00112
P1 ACC138/230	230	160	138	127	309 × 283 × 183	9331 437 10112
P1 ACC265/270	270	444	265	229	309 × 283 × 183	9331 437 20112
Three phase a.c. controllers						
P3 ACC14/330	330	—	14	13	180 × 283 × 183	9331 439 00112
P3 ACC35/400	400	—	35	32	438 × 164 × 183	9331 439 10112
P3 ACC110/400	400	160	110	100	438 × 283 × 183	9331 439 20112
P3 ACC265/400	400	400	265	230	438 × 447 × 183	9331 439 30112

PERIPHERAL DEVICES

Mosaic printers 60SA, catalogue number 4311 111 03370
60SR, catalogue number 4311 111 03380



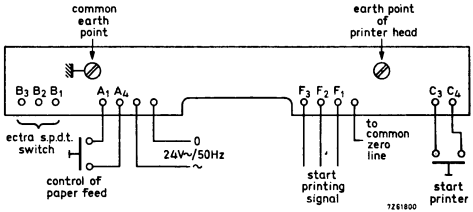
Application: These devices can print all characters that can be formed within a 5 × 7 dot matrix (with 5 columns of 7 dots each) on a standard paper roll of 60 mm width. The 60SR, equipped with an inked-ribbon (cal. No. 2811 062 06001) system, prints on ordinary paper (cat. No. 2811 063 10001), the 60SA is designed for printing on 3M's self-action paper (cat. No. 2811 063 10051).
The printers are controlled by a module CM20, containing the circuits for character generation and printer head drive.

Technical performance:

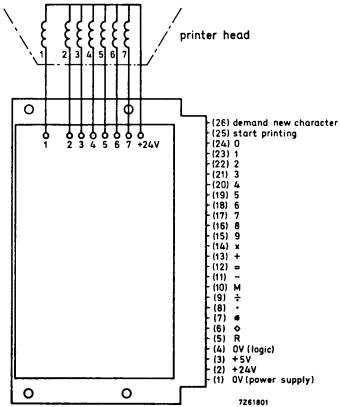
Character spacing	min. 3 columns, min. 0.7 mm
Line spacing	approx. 5 mm
Character width × height	max. 1.8 × 2.5 mm
Printing speed	50 characters per second
Line speed	60 lines of max. 20 characters per min.
Column capacity	adjustable between approx 18 and 20
Data entry	serial entry
Temperature range	
operating	0 to +55°C
storage	−25 to +55°C
Power supply	
– Printer head,	
voltage }	see CM20
current }	
– Motors,	
voltage	24 V ± 10 %, 50 Hz
current of	
printer head motor	200 mA
paper transport motor	60 mA
inked-ribbon transport motors (type 60SR only)	90 mA per motor
Width × depth × height	148 × 210 × 76 mm
mounting	6 holes of 3.7 mm (for self-tapping screws of 4 mm), 1 hole of 3.5 mm.

Electrical connections

The printer head is equipped with a 9-wires flexible cable of which 8-wires are to be connected to the character module and 1 wire to the earth point on the rear panel of the printer. The 8-wire connection is pluggable at the character module.
To the rear of the frame-work a small p.w. board is mounted. The pluggable connections are shown below.



20-Character module CM20, catalogue number 4311 111 02490



Terminal location

The module is provided with 26 contacts on the diode matrices printed-wiring board adapted to a single sided printed-wiring connector type FO45.
The amplifier printed-wiring board has 8 terminals, of which 7 are to be connected to the 7 solenoids on the printer head and one supplies the common 24 V.
Both types of Mosaic Printer are supplied with an 8-pole plug for the purpose.

Application: The 20-character module has been designed to control a mosaic printer type 60SA or 60SR. It selects and drives the various solenoids of the printer head in order to print the character selected at the character inputs.
Character input selection and character printing is performed serially. The logic voltage levels for all input and output terminals are adapted to the commonly used DTL and TTL integrated circuits.
The module consists of three major parts:
- the clock generator, decoding circuits for the scanning operation and start circuit.
- the character diode matrices.
- the solenoid amplifying circuits.

Technical performance

Characters available	numerals 0 to 9
Supply voltage	symbols – · + × ÷ * ◇ R M
solenoids	21.6 to 26.4 V, max. 28 V
module	4.75 to 5.25 V, max. 7.0 V
Power consumption	21 W
Operating temperature range	0 to 55°C
Width × depth × height	148 × 90 × 64 mm
mounting	4 holes of 3.2 mm

Logic levels

Character inputs. A character is selected when its input is at high level; all other inputs must be at low level.

Input HIGH	V min. 2.4 V
Input LOW	V max. 0.8 V

Start input. The electronic module is started when the start signal is at low level.

Input HIGH	V min. 2 V
Input LOW	V max. 0.6 V

Demand New Character output. When the signal "demand new character" is present this output is at low level.

Output HIGH	V min. 2.4 V
	$-I$ max. 0.4 mA
Output LOW	V max. 0.4 V
	I max. 16 mA
Fan-out	10 TTL gate loads

MICROWAVE DEVICES

Coaxial 3-port circulators

frequency MHz	*catalog number*	*insertion loss* $<(dB)$	*isolation* $>(dB)$	*V.S.W.R.* *max.*	*max. power* (W)	*dimensions (mm)* *diameter*	*height*
150– 160	2722 162 01361	0,3	20	1.25	1000	190[1])	96
160– 190	01371	0,35	20	1,25	1000	190[1])	96
170– 200	01191	0,4	20	1,2	500	190[1])	96
190– 220	01381	0,35	20	1,25	1000	190[1])	96
170– 200	01341	0,35	20	1,25	1000	190[1])	96
195– 230	01351	0,35	20	1,25	1000	190[1])	96
200– 230	01201	0,4	20	1,2	500		96
370– 402	01221	0,3	20	1,2	100	80	57
400– 470	01571	0,35	20	1,25	300	90×66[2])	52
400– 470	01621	0,35	20	1,25	300	74×66[2])	52
400– 800	01811	0,5	20	1,25	10	38×30[2])	20
406– 470	01151	0,4	20	1,2	100	80	57
445– 485	01231	0,3	22	1,2	100	80	57
470– 600	01121	0,35	22	1,2	500	110	71
470– 600	01161	0,35	20	1,25	100	80	58
470– 600	01261	0,35	20	1,25	2000	112	72
470– 600	01551	0,5	20	1,25	100	52×49[2])	27
470– 600	01581	0,35	20	1,25	300	74×66[2])	52
470– 600	01631	0,35	20	1,25	300	74×66[2])	52
590– 720	01131	0,35	22	1,2	500	110	71
590– 720	01171	0,35	22	1,2	100	80	57
590– 720	01281	0,35	22	1,2	2000	112	72
590– 720	01591	0,35	20	1,25	300	74×66[2])	52
590– 720	01641	0,35	20	1,25	300	74×66[2])	52
600– 800	01331	0,35	20	1,25	2000	112	72
600– 800	01561	0,5	20	1,25	100	52×49[2])	27

600– 800	01601	0,35	20	1,25	300	$74 \times 66^{2)}$	52
600– 800	01651	0,35	20	1,25	300	$74 \times 66^{2)}$	52
700–1270	01821	0,6	20	1,25	10	$32 \times 57^{2)}$	21
710– 860	01141	0,35	22	1,2	500	110	71
710– 860	01181	0,35	22	1,2	100	80	57
710– 860	01241	0,35	22	1,2	100	80	57
710– 860	01271	0,35	22	1,2	2000	112	72
710– 860	01611	0,35	20	1,25	300	$74 \times 66^{2)}$	52
710– 860	01661	0,35	20	1,25	300	$74 \times 66^{2)}$	52
2000–4000	01491	0,5	20	1,25	50	$67 \times 52^{2)}$	28
2000–4000	01501	0,5	20	1,25	50	$67 \times 52^{2)}$	24
3000–6000	01511	0,5	20	1,25	20	$47 \times 39^{2)}$	23

[1]) Triangular shape. [2]) Rectangular shape.

Waveguide 3-port circulators

frequency GHz	*catalog number*	*insertion loss* $<$ *(dB)*	*isolation* $>$ *(dB)*	*V.S.W.R. max.*	*max. power (W)*	*dimensions (mm)* [1])	*height*	*flange type*
3.4 –3.7	2722 161 02031	0.3	25	1.1	50	F–C = 50	74	C.C.T.U.no.6
3.4 –3.8	02161	0.2	28	1.08	50	◫ 120	69	I.E.C.–UER 40
3.6 –3.9	02041	0.3	25	1.1	50	F–C = 50	55	C.C.T.U.no.6
3.6 –4.2	02001	0.4	25	1.12	100	F–C = 58	55	I.E.C.–UER 40
3.6 –4.2	02011	0.3	28	1.1	50	◫ 120	82	I.E.C.–UER 40
3.8 –4.2	02151	0.2	28	1,08	50	◫ 120	69	I.E.C.–UER 40
5.925–6.425	02051	0.3	25	1.12	100	◫ 82.5	52	I.E.C.–UER 70
5.925–6.425	02101	0.2	30	1.06	100	◫ 83	53	I.E.C.–UER 70
6.425–7.125	02081	0.15	30	1.07	100	◫ 83	53	I.E.C.–UER 70
7.125–7.750	02091	0.2	30	1.06	100	◫ 83	53	I.E.C.–UER 70
7.7 –8.5	02021	0.3	25	1.1	50	57 × 65	58	I.E.C.– UER 84 / UBR 84

[1]) F-C = flange to centre.

Waveguide 4-port circulators

frequency GHz	*catalog number*	*insertion loss* $< (dB)$	*isolation* $\alpha_{1-3} > (dB)$	*isolation* $\alpha_{1-4} > (dB)$	*V.S.W.R. max.*	*max. power (W)*	*dimensions (mm)* ⏍	*height*	*flange type (I.E.C.)*
5.925– 6.175	2722 161 03081	0.1	33	20	1.05	150	70	57	UER 70
6.125– 6.425	03091	0.1	30	20	1.06	150	70	57	UER 70
6.575– 6.875	03031	0.4	25	20	1.1	100	70	57	UER 70
6.825– 7.125	03011	0.4	25	18	1.08	100	70	57	UER 70
7.125– 7.425	03001	0.3	25	18	1.1	100	70	57	UER 70
7.425– 7.725	03041	0.4	30	20	1.1	100	70	53	UER 70
10.700–11.700	03061	0.3	30	18	1.1	25	44.5	46	UBR 100
12.500–13.500	03051	0.3	25	20	1.1	25	38	45	UER 140 UBR 140

Coaxial isolators

frequency GHz	*catalog number*	*insertion loss < (dB)*	*isolation > (dB)*	*V.S.W.R. max.*	*max. power (W)*	*dimensions (mm)*	
						diameter	*height*
0.740–0.810	2722 162 02001	0.3	22	1.2	100	80	57.5
0.890–0.970	02011	0.3	22	1.2	100	80	57.5
1.48 –1.95	02041	0.3	20	1.2	50	65 × 70[1])	33
1.7 –2.3	02051	0.3	20	1.25	50	70 × 65[1])	33
2 –4	02091	0.5	20	1.25	50	67 × 52[1])	28
2 –4	02101	0.5	20	1.25	50	67 × 52[1])	24
2.7 –3.3	02081	0.3	20	1.25	100	72	28,5
2.96 –3.22	02021	0.3	20	1.2	100	72	28
3 –6	02071	0.5	20	1.25	20	47 × 39[1])	23
3.56 –3.90	02031	0.3	20	1.2	100	72	28
4 –8	02111	0.5	20	1.25	5	38 × 29,5[1])	20

[1]) Rectangular shape.

Waveguide isolators

frequency MHz	*catalog number*	*insertion loss* < (*dB*)	*isolation* > (*dB*)	*V.S.W.R. max.*	*max. power* (*W*)	*length* (*mm*)	*flange type I.E.C.*
3.650– 3.950	2722 161 01011	0.5	30	1.05	15	140	UER 40
3.800– 4.200	01081	0.5	30	1.05	10	180	UER 40
3.800– 4.200	01071	0.8	30	1.05	10	140	UER 48
3.900– 4.200	01021	0.5	30	1.05	15	140	UER 40
4.200– 4.600	01091	0.5	30	1.05	10	140	UER 48
4.600– 5.000	01101	0.8	30	1.05	10	140	UER 48
5.925– 6.425	01191	0.3	30	1.05	20	115	UER 70
6.425– 7.150	01251	0.3	30	1.05	20	115	UER 70
6.825– 7.425	01231	0.3	30	1.05	20	115	UER 70
7.125– 7.750	01291	0.3	30	1.05	20	115	UER 70
7.250– 7.750	01241	0.3	30	1.05	20	115	UER 70
7.400– 8.025	01151	0.5	30	1.05	10	115	UER 70
7.700– 8.500	01161	0.5	30	1.05	10	100	UBR 84
7.700– 8.500	01051	0.5	30	1.05	10	100	UER 84
8.500– 9.600	01211	0.5	30	1.05	10	76.2	UBR 100
8.500– 9.600	01221	0.6	15	1.15	1	35	UBR 100
8.500– 9.600	01261	1.2	55	1.20	10	99	UER 100
8.500– 9.600	01271	1.0	20	1.15	10	42.5	UBR 100
10.700–11.700	01171	0.8	30	1.05	5	80	UBR 100
12.500–13.500	01181	0.5	30	1.05	10	60	UBR 140

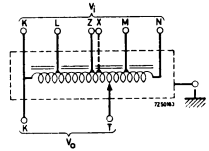
VARIABLE MAINS TRANSFORMERS

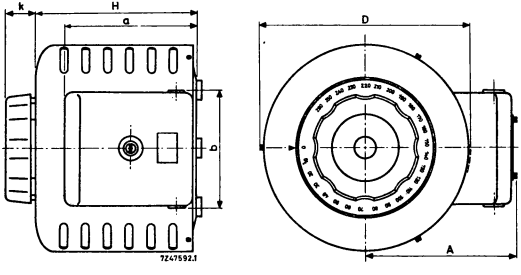
1–10 A (conventional types)

input voltage (*V*)	*output voltage* (*V*)	*nom. output current* (*A*)	*max. output current for const.* Z_{load} (*A*)	*catalog number* 2422 530		
				bench model with knob	*panel model without knob*	*laboratory model with socket*
130	0–150	2.5	3.2		02306	
		5	6.3		03306	
		10	12.6		04306	
220	0–220	6.5	7.5		14406	
		10	12		15406	
220	0–260	1	1.4	02401	02406	
		2.5	3.2	03401	03406	03405
		5	6.3	04401	04406	04405
		8.5	11.2	05401	05406	05405
240	0–270	1	1.4	02501	02506	
		2.5	3.2	03501	03506	
		5	6.3	04501	04506	
		8.5	11.2	05501	05506	

VARIABLE MAINS TRANSFORMERS

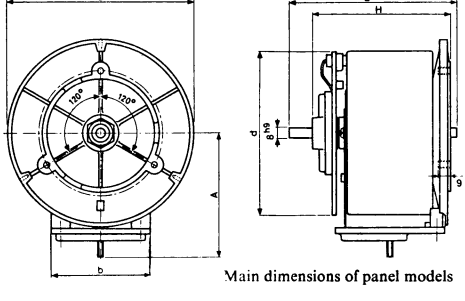
K-L = M-N = 18 % of K-N
Z = centre tap
X = optional tap





Main dimensions of bench models and laboratory models

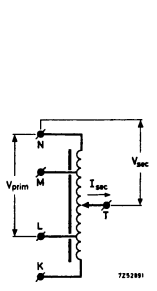
catalog number 2422 530 0....		dimensions (mm) H	D	A	a	b	k
2401	2501	122	113	79	99	77	21
3401	3501	123	134	93	100	77	21
4401	4501	131	166	117	106	92	24
5401	5501	133	193	134	106	92	24



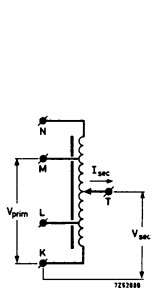
Main dimensions of panel models

catalog number 2422 530				dimensions (mm) H	D	A	d	b	L
02306	02406	02506	14406	110	106	63	93	71	153
03306	03406	03506	15406	112	127	74	110	71	153
04306	04406	04506		117	158	92	140	84	157
	05406	05506		120	185	106	168	84	157

input voltage (V)	*output voltage (V)*	*nom. output current (A)*	*max. output current for const. Z_{load} (A)*	*catalog number* 2422 530 ..... *(transformer)*	*catalog number of knob with dial*
220	0–220	15	18	16407	2922 511 90056
220	0–260	12	15	06407	2922 511 90058
240	0–260	12	15	06507	2922 511 90058

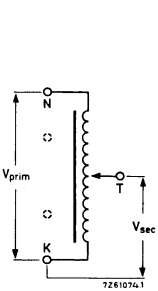


on panel

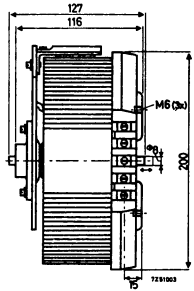


behind panel

types 06407 and 06507



on panel
(type 16407)

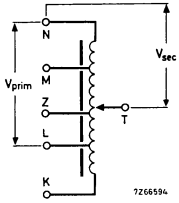


VARIABLE MAINS TRANSFORMERS

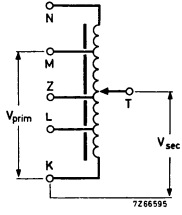
23 A (conventional types)

input voltage (*V*)	*output voltage* (*V*)	*nom. output current* (*A*)	*max output current for const.* Z_{load} (*A*)	*catalog number* 2422 530 ..... *bench model with knob*	*panel model without knob*[1])
220	0–260	23	30	07401	07406
240	0–260	23	30	07501	07506

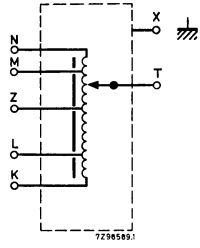
[1]) And without feet. A knob is separately available under No. 2922 511 90028, a dial under Cat. No. 4322 026 18560.



Mounting behind panel

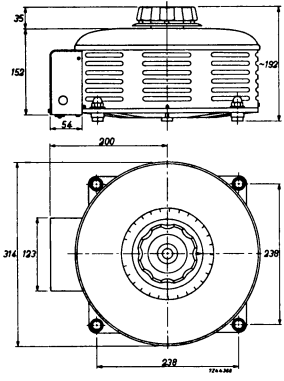


Mounting on panel



Bench model

K-L = M-N = 18 %
Z = centre tap

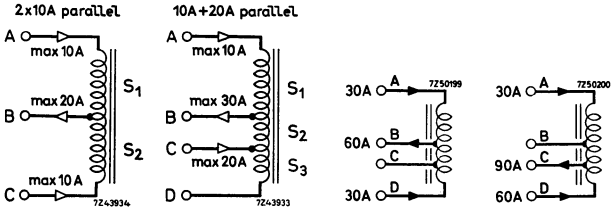


Main dimensions of bench models

Accessories for conventional transformers

Chokes

For parallel mounting of two or three transformers, chokes should be inserted between the secondaries to prevent high interchange currents caused by small differences in the ganging.



$S_1:S_2 = 1:1$

Catalog number
2422 532 00014

$S_1:S_2:S_3 = 2:1:1$

Catalog number
2422 532 00013

Catalog number
2422 532 00017

Ganging units

For ganging two or three transformers, sets of standard ganging units are available for bench and panel models.

Motor drive modules

All transformers, either stacked or individual, can be provided with remote controlled motor drives. These motor drives are supplied as kits with easy to assemble loose parts. Two types of synchronous motors together with a series of gear boxes permit a choice out of a large range of speeds.

A.C. stabiliser module BEY 801

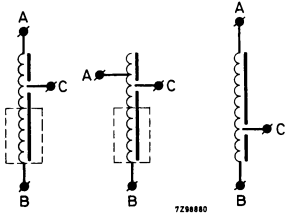
This module is capable of stabilising voltages to a value set by means of a control potentiometer.
Accuracy of stabilisation: ± 1 V.
The voltage to be stabilised can vary between -15% and $+10\%$ of the desired value.

VARIABLE MAINS TRANSFORMERS

Moulded transformers

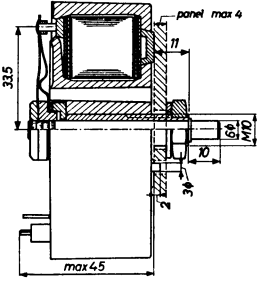
input voltage (V)	*output voltage (V)*	*nom. output current (A)*	*direction of rotation* [1])	*output connections*	*catalog number*
60	0–60	1.2	CW	CB	2422 530 00007
			CCW	CA	
220	110–220	0.5	CW	CB	2422 530 00407
	0–110		CCW	CA	
240	120–240		CW	CB	
	0–120		CCW	CA	

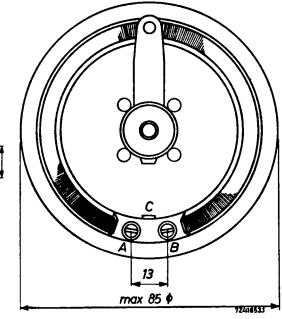
[1]) Seen from extending spindle end;
CW = clockwise,
CCW = counter clockwise.



Transformer 2422 530 00407

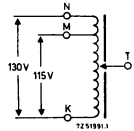
Transformer 2422 530 00007



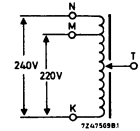


Moulded transformers (continued)

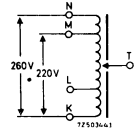
input voltage (*V*)	*output voltage* (*V*)	*nom. output current* (*A*)	*max. output current for const.* Z_{load} (*A*)	*catalog number*
70	0–70	5.5	5.5	2422 530 13707
115/130	0–130	1.2	1.4	2422 530 01607
115	0–115	1.4	1.7	2422 530 11607
220	0–220	0.83	1.0	2422 530 11407
		1.4	1.7	2422 530 18407
		2.5	3.0	2422 530 13407
220/ 240	0–240	0.7	0.83	2422 530 01407
220/ 260	0–260	1.2	1.4	2422 530 08407
		2.0	2.4	2422 530 03407
240/ 260	0–260	2.0	2.4	2422 530 03507



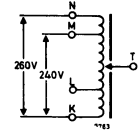
Transformer
2422 530 01607



Transformer
2422 530 01407

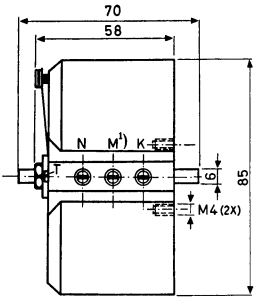


Transformers
2422 530 03407
2422 530 08407

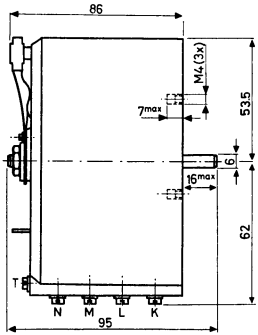


Transformer
2422 530 03507

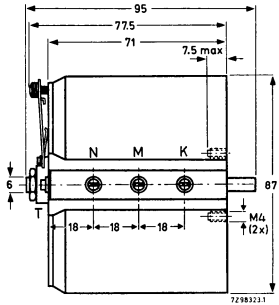
VARIABLE MAINS TRANSFORMERS



Transformers 2422 530 01407
and 2422 530 01607



Transformers 2422 530 03407
2422 530 03507
2422 530 13407
2422 530 13707



Transformers 2422 530 08407
18407

[1]) (Without connecting M for types 2422 530 11407)
2422 530 11607)

Transformers with separate windings

Input voltage	220 V
Output voltage (no load)	248 V
Nom. output current	3 A

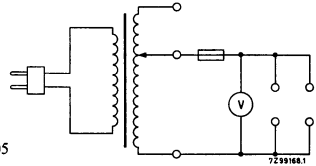


Diagram of
bench model 2422 529 00005

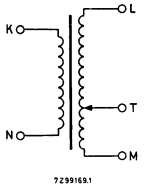
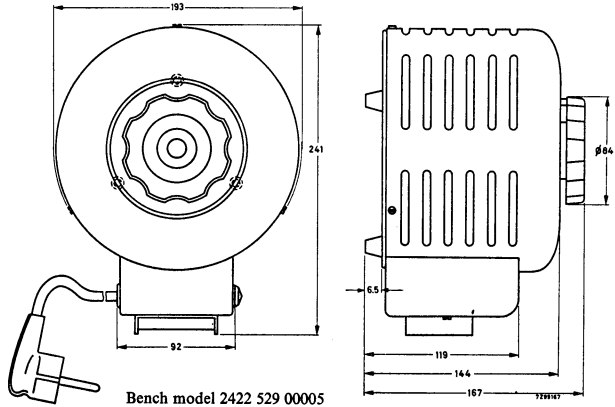


Diagram of panel model
2422 529 00006



Bench model 2422 529 00005

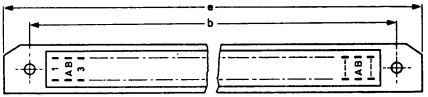
ELECTRO-MECHANICAL COMPONENTS

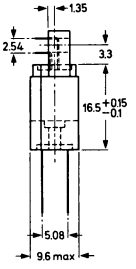
Printed-wiring connectors

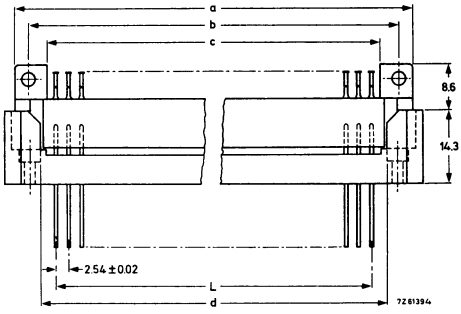
Type number: F 054
Colour: green or blue
These connectors are composed of a board part and a panel part.
Contact pitch: 0.1″ (2.54 mm)
Number of connections: 32, 48, 64, 96 [1])
Max. r.m.s. voltage: 250 V
Max. current at ⩽ 85°C: 3 A
Material of body: glass fibre filled diallylphthalate (blue) or glass fibre filled polyester resin (green)

Contact termination
of panel part: solder tags
dipsolder pins
wire wrap pins
of boardpart: dipsolder pins

[1]) Only with blue diallylphthalate body







number of connections (double sided)	*L*	a_{max}	*b*	c_{min}	*d*	e_{max}
32	38.10	54.5	48.3	41.4	44.0	58.3
48	58.42	68.6	68.6	61.7	64.3	78.6
64	78.74	95.0	88.9	82.0	84.6	98.9
96	119.38	135.7	129.5	122.64	125.2	139.5

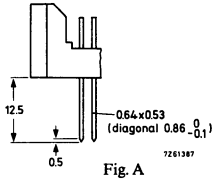


Fig. A

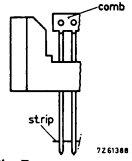


Fig. B

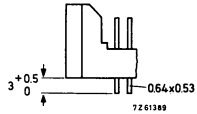


Fig. C

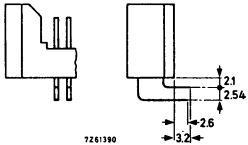


Fig. D

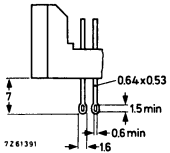


Fig. E

Fig. A. Panel part with wire wrap pins

Fig. B. Panel part with wire wrap pins (back panel version).

Fig. C. Panel part with straight dipsolder pins.

Fig. D. Panel part with hooked dipsolder pins.

Fig. E. Panel part with solder tags.

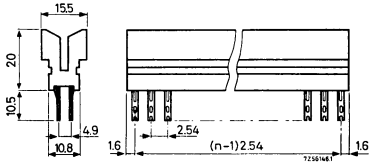
number of connections	*body mat.*	*catalogue number* 2422 025 89...					
		panel part according to					*board part*
		Fig. A	*Fig. B*	*Fig. C*	*Fig. D*	*Fig. E*	
32	diallylphthalate	117	118	119	122	121	114
48		123	124	125	127	126	115
64		128	129	131	133	132	116
96		211	212	213	215	214	209
32	polyester	183	184	185	198	186	182
48		188	189	191	199	192	187
64		194	195	196	201	197	193

ELECTRO-MECHANICAL COMPONENTS

Type number	: F 058
Colour	: black
Contact pitch	: 0.1" (2.54 mm)
Number of connections	: 4 to 45, single-sided
	: 8 to 90, double-sided
Max. r.m.s. voltage	: 100 V
Max. current at $\leqslant 100°C$	: 5 A
Material of body	: tropic proof phenolic resin
Catalog number	: 2422 023 1 . . . .

version, see table

number of positions (n)
06, 07,
08, 09, 10 or up to 45



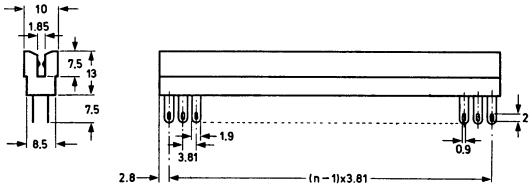
version	*number of contact positions containing a contact*	*version indication*
single-sided	all	02
double-sided	all	12
single-sided	all but the two outermost	04
double-sided	all but the two outermost	14

Type number : F 046
Colour : black
Contact pitch : 0.15" (3.81 mm)
Number of connections : 4 to 45, single sided
8 to 90, double sided
Max. r.m.s. voltage : 250 V
Max. current at ⩽43°C : 3 A
Material of body : tropic proof phenolic resin
Catalog number : 2422 0 . . 6 . . . .

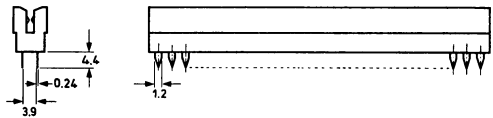
termination code
36 = solder tags
42 = dipsolder pins

version
see table

number of contact positions (n) 06, 07, 08, 09, 10 or up to 45



Connector with solder tags

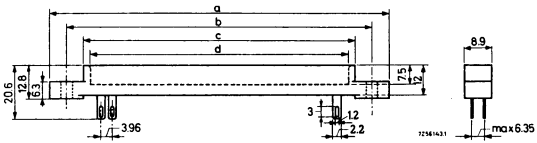


Connector with dipsolder pins

version	*number of contact positions containing a spring*	*version indication*	
		⩾0,75 µm gold plate on contact face	*⩾0.2 µm gold plate on contact face*
single-sided	all	02	42
double-sided	all	12	52
single-sided	all but the two outermost	04	44
double-sided	all but the two outermost	14	54

ELECTRO-MECHANICAL COMPONENTS

Type number : F 047
Colour : blue
Contact pitch : 0.156″ (3.96 mm)
Number of connections : 6, 10, 15, 18, 22, single-sided
12, 20, 30, 36, 44, double-sided
Max. r.m.s. voltage : 250 V
Max. current at $\leqslant 85°C$: 5 A
Material of body : glass fibre filled diallylphthalate
Contact termination : solder tag
Catalog number : 2422 037 . . . . .



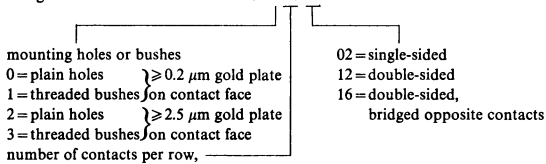
mounting holes or bushes
4 = threaded bushes, 5 = plain holes } ≥ 2.5 μm gold plate on contact face
6 = threaded bushes, 7 = plain holes } ≥ 1.3 μm gold plate on contact face
number of contacts per row, 06, 10 etc.

02 = single-sided
12 = double-sided
16 = double-sided, bridged opposite contacts

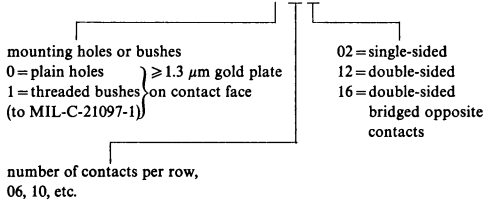
number of contact springs per row	a_{max}	*b*	c_{max}	*d*
6	47.3	38.9	32.6	27.9
10	63.2	54.8	48.4	43.8
15	83.0	74.6	68.3	63.6
18	94.9	86.5	80.2	75.5
22	110.7	102.4	96.1	91.3

Type number : F 050
Colour : green
Material of body : glass fibre filled polyester
For further data, see F 047

Catalog numbers: 2422 037 . . . . .

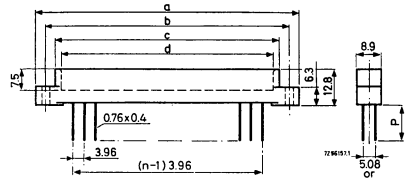

mounting holes or bushes
0 = plain holes
1 = threaded bushes
≥ 0.2 μm gold plate on contact face
2 = plain holes
3 = threaded bushes
≥ 2.5 μm gold plate on contact face
number of contacts per row,
06, 10 etc.
02 = single-sided
12 = double-sided
16 = double-sided, bridged opposite contacts

2422 040 . . . . .


mounting holes or bushes
0 = plain holes
1 = threaded bushes (to MIL-C-21097-1)
≥ 1.3 μm gold plate on contact face
02 = single-sided
12 = double-sided
16 = double-sided bridged opposite contacts
number of contacts per row,
06, 10, etc.

ELECTRO-MECHANICAL COMPONENTS

Type number : F 053
Colour : red
Contact pitch : 0.156″ (3.96 mm)
Number of connections
single-sided : 6, 10, 15, 18, 22, 28, 36, 43
double-sided : 12, 20, 30, 36, 44, 56, 72, 86
Max. r.m.s. voltage : 250 V
Max. current at ⩽ 65°C : 5 A
Material of body : glass fibre filled polycarbonate



P=13mm for wire-wrap terminations
3.75mm for dipsolder terminations

Catalog number : 2422 0 . . . .

termination code
39 = pins for wire-wrapping
44 = dipsolder pins

0 = plain holes } pitch of opposite
1 = threaded bushes } terminations 5.08 mm
4 = plain holes } pitch of opposite
5 = threaded bushes } terminations 3.55 mm

number of contacts per row 06, 10, etc.

02 = single-sided } ⩾0.2 μm gold plate
12 = double-sided } on contact face
42 = single-sided } ⩾0.2 μm gold plate
52 = double-sided } on contact face

number of contacts per row (n)	a_{max}	*b*	c_{max}	*d*
6	47.34	38.91	32.56	27.94
10	63.19	54.76	48.43	43.79
15	83.00	74.62	68.27	63.60
18	94.89	86.51	80.18	75.49
22	110.7	102.41	96.06	91.34
28	134.21	126.09	118.97	115.11
36	166.19	157.99	150.67	146.76
43	193.82	185.47	178.61	174.55

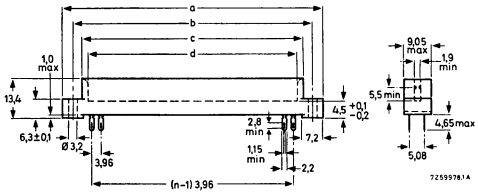
Type number	: F 064
Colour	: green
Contact pitch	: 0.156″ (3.96 mm)
Number of connections	
single-sided	: 6, 10, 15, 18, 22, 28, 36, 43
double-sided	: 12, 20, 30, 36, 44, 56, 72, 86
Max. r.m.s. voltage	: 250 V
Max. current at ⩽ 75°C	: 5 A
Material of body	: glass fibre filled polyester resin

Catalog number : 2422 047 1....

number of contacts per row 06, 10 etc.

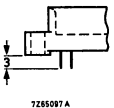
finish of faces
1 = 0,4 μm gold plate
2 = 1 μm gold plate
3 = 4 μm rolled gold
4 = 3,5 μm gold plate

0 = single sided } with
1 = double sided } solder tags
2 = single sided } with pins
3 = double sided } for wire wrap
4 = single sided } with
5 = double sided } dipsolder pins

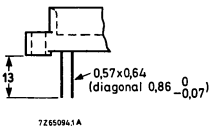


connector with solder tags

number of contacts per row (n)	a_{max}	*b*	c_{max}	*d*
6	46,64	39,04	31,64	27,89
10	62,48	54,88	47,88	43,73
15	82,28	74,68	67,28	63,53
18	94,16	86,56	79,16	75,41
22	110,00	102,40	95,00	91,25
28	133,76	126,16	118,76	115,01
36	165,44	157,84	150,44	146,69
43	193,16	185,66	178,16	174,41



connector with dipsolder pins



connector with pins for wire wrap

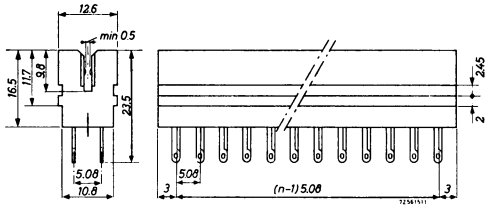
ELECTRO-MECHANICAL COMPONENTS

Type number	: F 045
Colour	: black
Contact pitch	: 0.2" (5.08 mm)
Number of connections	: 1 to 54, single-sided 2 to 108, double-sided
Max. r.m.s. voltage	: 250 V
Max. current at $\leqslant 58°C$	: 5 A
Material of body	: tropic proof phenolic resin
Catalog number	: 2422 0 . . 5 . . . .

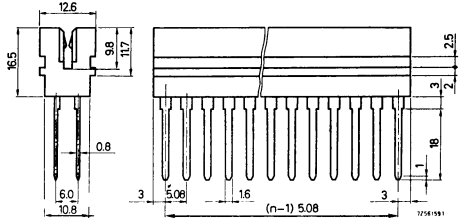
termination code
20 = solder tags
35 = wire-wrap pins

number of contact positions
single-sided (n), 03, 04,
etc., 10 or up to 54

version, see table



Connector with solder tags



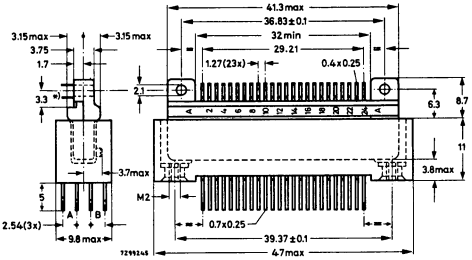
Connector with wire-wrap pins

version	*number of contact positions containing a contact*	*version indication*	
single-sided	all	02	for a board thickness of 1.6 mm
double-sided	all	12	
single-sided	all but the two outermost	04	⩾0.75 μm gold plate on contact face
double-sided	all but the four outermost	14	
single-sided	all	22	for a board thickness of 2.4 mm ⩾0.75 μm gold plate on contact face
double-sided	all	32	
single-sided	all but the two outermost	24	
double-sided	all but the four outermost	34	
single-sided	all four	42	for a board thickness of 1.6 mm ⩾0.2 μm gold plate on contact face
double-sided	all	52	
single-sided	all but the two outermost	44	
double-sided	all but the four outermost	54	
single-sided	all	62	for a board thickness of 2.4 mm ⩾0.2 μm gold plate on contact face
double-sides	all	72	
single-sided	all but the two outermost	64	
double-sided	all but the four outermost	74	

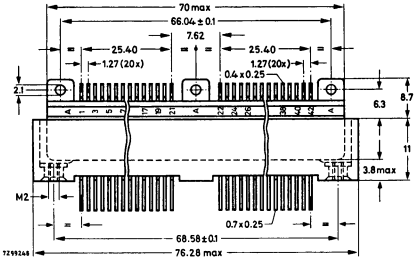
ELECTRO-MECHANICAL COMPONENTS

Type number	: F 057
Colour	: blue
Contact pitch	: 0.05" (1.27 mm)
Number of connections	: 48, 84, 116 (double-sided)
Max. r.m.s. voltage	: 100 V
Max. current at $\leqslant 65°C$	: 2 A
Material of body	: glass fibre filled diallylphthalate

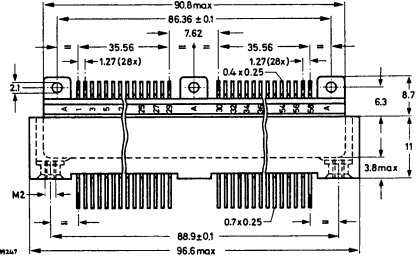
These connectors consist of a board part and a panel part.



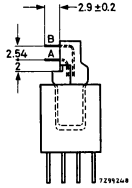
Connector with 48 connections
*) See various terminal configurations



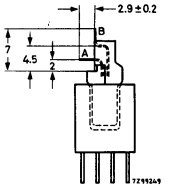
Connector with 84 connections



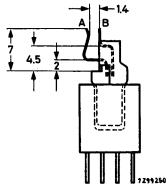
Connector with 116 connections



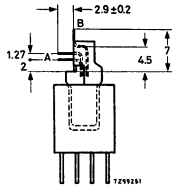
Terminal configuration A



Terminal configuration B



Terminal configuration C



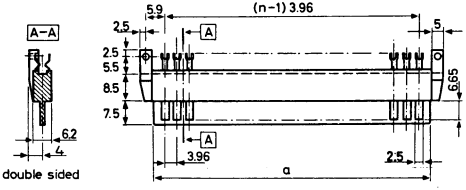
Terminal configuration D

number connections	*terminal configuration of the board part*	*catalog number*	
		board part	*panel part*
48	A	2422 025 89136	2422 025 89139
	B	89137	
	C	89142	
	D	89167	
84	A	89157	2422 025 89162
	B	89158	
	C	89161	
	D	89169	
116	A	89147	2422 025 89152
	B	89148	
	C	89151	
	D	89172	

ELECTRO-MECHANICAL COMPONENTS

Printed-wiring interconnectors

Type number : F048
Colour : blue
Contact pitch : 0.156″ (3.96 mm)
Max. r.m.s. voltage : 250 V
Max. curr. at ⩽ 80°C : 5 A
Material of body : glass fibre filled diallylphthalate



number of contact springs per row (n)	*a (mm)*	*catalog number single-sided version*	*catalog number double-sided version*
6	27.74	2422 025 89033	2422 025 89038
10	43.58	89034	89039
15	63.40	89035	89041
18	75.30	89036	89042
22	91.10	89037	89043

Type number : F 051
Colour : green
Material of body : glass fibre filled thermosetting material

For further data, see F 048

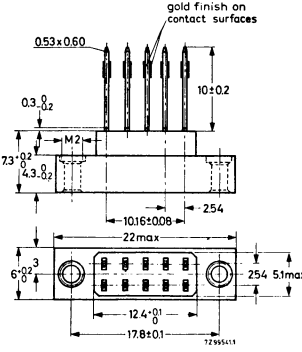
number of contact springs per row(n)	*catalog number single-sided version*	*catalog number double sided version*
6	2422 025 89.71	2422 025 89.76
10	2422 025 89·72	2422 025 89.77
15	2422 025 89.73	2422 025 89.78
18	2422 025 89.74	2422 025 89.79
22	2422 025 89.75	2422 025 89.81

0 = ⩾3 μm rolled gold } finish of
2 = ⩾0.2 μm gold plate } contact face

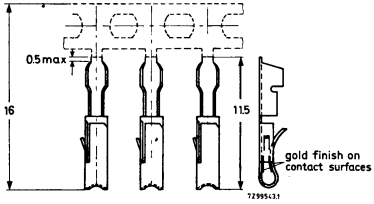
Type number : F 066
Colour : grey

This connector consists of a panel part and a cable part.

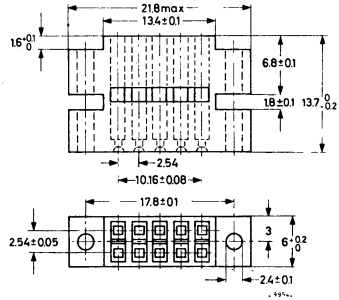
Contact pitch : 0,1 in (2,54 mm)
Number of connections : 10
Max. r.m.s. voltage : 125 V
Max. current at ⩽ 40°C : 3 A
Material of body : glass fibre filled thermoplastic
Terminations
of panel part : pins for mini wire wrap
of cable part : crimp-snap-in contacts



Panel part, catalogue number 2422 825 89145



Crimp-snap-in contact springs, in continuous tape, catalogue number for one piece 4332 026 14280



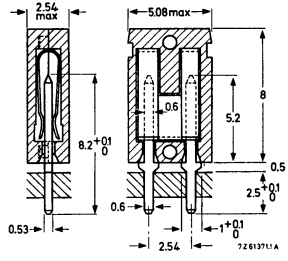
Housing of cable part, catalogue number 4332 026 14180

ELECTRO-MECHANICAL COMPONENTS

Type number : F 088
Colour : grey

This connector consists of two contact pins for dipsolder mounting and a female plug.

Contact pitch : 0,1 in (2,54 mm)
Number of connections : 2
Max. r.m.s. voltage : 125 V
Max. current at $\leqslant 55°C$: 3 A
Material of body : glass fibre filled thermoplastic
Pin termination : dipsolder
Catalogue number
of female plug : 2422 024 88003
of pin : 4332 026 16770
of 2 × 16 pins on a strip : 2422 025 89303



Mounting chassis for printed-wiring boards

All chassis are metal frames which can be mounted in standard 19 inch racks. Board thickness 1.6 ± 0.2 mm.

connectors				*printed-wiring boards*			
type	*contact pitch (mm)*	*numbers of contacts*	*method of connection*	*dimensions h × l (mm)*	*min. pitch in chassis (mm)*	*max. number*	*chassis (cat. number)*
F054	2.54	2 × 32	mini wire-wrap back panel dip soldering	116.8 × 98	10.16	41	4322 026 38250 4322 026 38280
F047, F050 F053, F064	3.96	1 or 2 × 22	hand soldering mini wire-wrap	116.8 × 110	10.16	41	4322 026 38310
F047, F050, F053, F064	3.96	1 or 2 × 22	hand soldering mini wire-wrap	121.8 × 204	19.35 12.9	21 30	4322 026 38230 4322 026 38260
special F045	5.08	1 or 2 × 23	hand soldering or wire-wrap	121.8 × {204 or 180}	19.35 12.9	21 30	4322 026 38240 4322 026 38270

ELECTRO-MECHANICAL COMPONENTS

Printed-wiring boards

	to fit chassis 4322 026	*ma-terial*	*con-tacts*	*contact pitch*	*hole ø (mm)*	*with extractor*	*dimensions (mm)*	*cat. number* 4322 026 .....
For general purposes								
exp., 0.1″ grid	38230	gl.	2 × 22	0.156″	0.8	×	121.8 × 207.0	38640
exp., 0.1″ grid	38240	gl.	2 × 23	0.2″	0.8	×	121.8 × 207.0	38650
exp.	38310	gl.	2 × 35	0.1″	0.8 p.t.	—	116.8 × 110.2	74670
exp.[1])	38250 38280	gl.	2 × 32	0.1″	0.8 p.t.	–	98.2 × 116.8	39880
exp.[2])	38250 38280	gl.	2 × 32	0.1″	0.8 p.t.	–	98.2 × 116.8	39890
For 1-*Series* circuit blocks (0.2″ grid)								
exp.	—	ph.	2 × 38	0.2″	1.3	–	200 × 396	34900
exp.	—	ph.	4 × 38	0.2″	—	–	200 × 396	34910
exp.	38230	ph.	2 × 22	0.156″	1.3	×	121.8 × 207.0	38620
exp.	38240	ph.	2 × 23	0.2″	1.3	×	121.8 × 207.0	38630
exp.	38240	gl.	2 × 23	0.2″	1.3	×	121.8 × 207.0	38690
exp.	38240	ph.	1 × 23	0.2″	1.3	—	121.8 × 180.3	34940
univ.	38240	ph.	1 × 23	0.2″	1.3	—	121.8 × 180.3	34920
univ. (8 blocks)		ph.	1 × 23	0.2″	1.2 p.t.	—	121.8 × 180.3	34960
univ.		ph.	1 × 23	0.2″	1.2 p.t.	—	121.8 × 180.3	36310
for 4 blocks PA 1	38240	gl.	1 × 23	0.2″	1.2 p.t.	—	121.8 × 180.3	33630
for 4 blocks PD 1		gl.	1 × 23	0.2″	1.2 p.t.	—	121.8 × 180.3	34710

	to fit chassis 4322 026.....	*ma-terial*	*con-tacts*	*contact pitch*	*hole Ø (mm)*	*with extractor*	*dimensions (mm)*	*cat. number* 4322 026.....
For 10-*Series* circuit blocks (0.1″ grid)								
univ. (8 blocks)	38240	ph.	1 × 23	0.2″	1.2 p.t.	–	121.8 × 180.3	34950
exp. (20 blocks)	38240	gl.	2 × 23	0.2″	1.2 p.t.	×	121.8 × 207.0	38600
exp. (20 blocks)	38240	ph.	2 × 23	0.2″	1.2 p.t.	×	121.8 × 207.0	38610
exp. (10 low cases)	38220 38240	ph.	2 × 23	0.2″	1.2 p.t.	—	121.8 × 200.6	36270
for 4 blocks PA10	38240	gl.	2 × 23	0.2″	p.t.	×	121.8 × 207.0	38680
of assembly DCA10	38240	gl.	2 × 23	0.2″	p.t.	×	121.8 × 207.0	38700
of assembly 2.DCA11	38240	gl.	2 × 23	0.2″	p.t.	×	121.8 × 207.0	38710
of assembly 2.DCA12	38240	gl.	2 × 23	0.2″	p.t.	×	121.8 × 207.0	38720
of assembly BCA10	38240	gl.	2 × 23	0.2″	p.t.	×	121.8 × 207.0	38730
of assembly 2.SRA10	38240	gl.	2 × 23	0.2″	p.t.	×	121.8 × 207.0	38740
of assembly RSR10	38240	gl.	2 × 23	0.2″	p.t.	×	121.8 × 207.0	38750

[1]) For dual-in-line packages with 2 × 7 pins. [2]) For dual-in-line packages with a different number of pins.

For Norbits 60-Series								
exp.	38240	gl.	2 × 23	0.2″	1.2 p.t.	×	121.8 × 207.0	38600
exp.	38240	ph.	2 × 23	0.2″	1.2 p.t.	×	121.8 × 207.0	38610
with 0 V and + tracks[1])	38230	gl.	2 × 22	0.156″	1.3 p.t.	×	121.8 × 207.0	38790
with 0 V and + tracks[1])	38230	ph.	2 × 22	0.156″	1.3 p.t.	×	121.8 × 207.0	38800
with 0 V and + tracks[1])	38240	gl.	2 × 23	0.2″	1.3 p.t.	×	121.8 × 207.0	38810
with 0 V and + tracks[1])	38240	ph.	2 × 23	0.2″	1.3 p.t.	×	121.8 × 207.0	38820
with 0 V and + tracks, and F054 connector[2])	38250	gl.	2 × 32	0.1″	1.2	×	116.8 × 98	38780
univ.	38330	gl.	—	—	1.2	–	88.9 × 182.9	73750

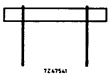
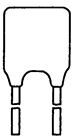
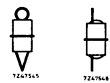
The p.w. board thickness is 1.6 mm
The contacts are gold plated.
Abbreviations: exp. = experimenters' p.w. board
univ. = p.w. board universal for the given series of circuit blocks
gl. = glass epoxy
ph. = phenol paper
p.t. = plated-through

[1]) Accommodation 10 size A [2]) Accommodation 4 size A

CERAMIC CAPACITORS

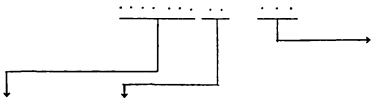
Class 1 = for tuning and other applications where low losses and a linear temperature dependence are required.

Class 2 } = for all coupling and decoupling purposes.
Class 3 }

type	*basic catalogue number*	*application*	*capacitance range (pF)*	*rated voltage (V d.c.)*
Tubular capacitors				
	2222 552	class 2	680 to 22 000	500
	2222 555	class 1	0,8 to 820	500
	2222 562	safety	10 to 560	700
Upright-mounting-capacitors	2222 563	class 2	1,5 to 10 000	500
	2222 565		2200 to 10 000	
Disc capacitors				
	2222 625	class 1	0,47 to 33	500
	2222 627	class 2	220 to 1500	500
Plate capacitors	2222 629	class 2	180 to 4 700	100
	2222 630		1000 to 22 000	40
	2222 631	class 1	0,68 to 560	63/100
	2222 632			
	2222 638			
	2222 641			
	2222 643			
	2222 650	class 1	0,47 to 220	500
	2222 655	class 2	100 to 2700	500
	2222 675	class 3	22 000 to 100 000	6
Feed through capacitors				
	2222 700	class 1	2,5 to 47	
	2222 700	class 2	68 to 2200	350
	2222 702	class 2	2,5 to 4700	

CERAMIC CAPACITORS

Composition of the catalogue number (for ordering)


code for multiplying factor
7 = × 0,01
8 = × 0,1
9 = × 1
1 = × 10
2 = × 100
3 = × 1000
capacitance code:
first 2 digits of capacitance value (pF)
followed by multiplying factor

basic catalogue number	*version code*	*capacitance range (pF)*	*series*	*colour marking*
2222 552	03 = non insulated 04 = insulated	680 to 22 000	E6	see colour code
2222 555	57 = ± tolerance 0,25 pF 56 = ± tolerance 0,5 pF 56 = ± tolerance 0,5 pF	0,8 to 2,2 2,7 to 10 12 to 820	E12	see colour code
2222 562	01	10 to 560	E12	
2222 563	01 = ± tolerance 0,1 pF 02 = ± tolerance 20% 03 = ± tolerance −20/+50%	1,5 to 10 15 to 680 1000 to 10 000	E6	none
2222 565	02 = ± tolerance −20/+50%	2200 to 10 000	E6	none
2222 625	tolerance ± / temp. coefficient (ppm/degC)			
	03 = 0,25 pF +100	0,47 to 2,2		red/violet
	02 = 0,5 pF +100	2,7 to 5,6		red/violet
	09 = 0,25 pF 0	1,8 and 2,2		black
	08 = 0,5 pF 0	2,7 to 10		black
	08 = 5 % 0	12 and 15		black
	33 = 0,25 pF −150	2,2	E12	orange
	32 = 0,5 pF −150	2,7 to 10		orange
	32 = 5 % −150	12 to 18		orange
	57 = 0,25 pF −750	1,8 and 2,2		violet
	56 = 0,5 pF −750	2,7 to 10		violet
	56 = 5 % −750	12 to 33		violet

baisc catalogue number	*version code*			*capacitance range (pF)*	*series*	*colour marking*
2222 627	14 = ± tolerance −20/+50%			100 to 1500	E6	none
		lead spacing, (mm)	length (mm)	dia (mm)			
2222 629	01 = 2,54	⩾15	0,6	1000 to 22 000	E3	green
	02 = 2,54	⩾15	0,4			
	03 = 5,08	⩾15	0,6			
	05 = 2,54	6	0,6			
	06 = 5,08	6	0,6			
	07 = 3,0	⩾10	0,6			
2222 630	01 = 2,54	⩾15	0,6	180 to 4700	E12	yellow
	02 = 2,54	⩾15	0,4			
	03 = 5,08	⩾15	0,6			
	05 = 2,54	6	0,6			
	06 = 5,08	6	0,6			
	07 = 3,0	⩾10	0,6			
		tolerance ±	temp. coefficient (ppm/deg C)			
2222 631	03 = 0,25 pF	+100		0,68 to 8,2	E12	red/violet
632	04 = ±2%	+100		10 to 22		
638	09 = 0,25 pF	0		1,8 to 8,2		black
641	10 = 2%	0		10 to 120		
643	27 = 0,25 pF	− 75		3,9 to 8,2		red
	28 = 2%	− 75		10 to 120		
	33 = 0,25 pF	−150		3,9 to 8,2		orange
	34 = 2%	−150		10 to 150		
	39 = 0,25 pF	−220		3,9 to 8,2		yellow
	40 = 2%	−220		10 to 150		
	45 = 0,25 pF	−330		4,7 to 8,2		green
	46 = 2%	−330		10 to 180		
	51 = 0,25 pF	−470		6,8 to 8,2		blue
	52 = 2%	−470		10 to 220		
	57 = 0,25 pF	−750		3,9 to 8,2		violet
	58 = 2%	−750		10 to 330		
	70 = 2%	−1500		18 to 560		−orange/orange

CERAMIC CAPACITORS

basic catalogue number	*version code*		*capacitance range (pF)*	*series*	*colour marking*
2222 650	03 = 0,25 pF	+100	0,47 to 8,2	E12	red/violet
	04 = 2%	+100	10 to 27		
	09 = 0,25 pF	0	0,82 to 8,2		black
	10 = 2%	0	10 to 39		
	33 = 0,25 pF	−150	2,2 to 8,2	E12	orange
	34 = 2%	−150	10 to 47		
	57 = 0,25 pF	−750	1,8 to 8,2		orange
	58 = 2%	−750	10 to 82		
	69 = 0,25 pF	−1500	8,2		orange/orange
	70 = 2%	−1500	10 to 220		
2222 655	03 = ±10%		100 to 2700	E12	none
2222 675	01 = 0,6 mm leads 02 = 0,4 mm leads		22 000 to 100 000	E3	none
2222 700	00 = without tolerance		2,5*)	E6	*) code = 25
	01 = ±0,5 pF		3,3 and 4,7		
	02 = ±1 pF		6,8 and 10		
	03 = ±10%		15 to 47		
	04 = ±20%		68 to 680		
	05 = −20/+50%		1000 to 2200		
2222 702	04 = ±0,5 pF		2,5*) to 6,8	E6	*) code = 25
	05 = ±10%		10 to 68		
	08 = ±20%		100 to 470		
	09 = −20/+50%		680 to 4700		

Colour code

	temperature coefficient	*first digit*	*second digit*	*multiplier for the capacitance*	*tolerance on capacitance* $C \leqslant 10$ *pF* (*pF*)	$C > 10$ *pF* (%)
red/violet	P100					
black	NP0		0	1		±20
brown	N033	1	1	10	±0.1	±1
red	N075	2	2	10^2	±0.25	±2
orange	N150	3	3	10^3		
yellow	N220	4	4	10^4		
green	N330	5	5		±0.5	±5
blue	N470	6	6			
violet	N750	7	7			
grey		8	8	10^{-2}		
white		9	9	10^{-1}	±1	±10

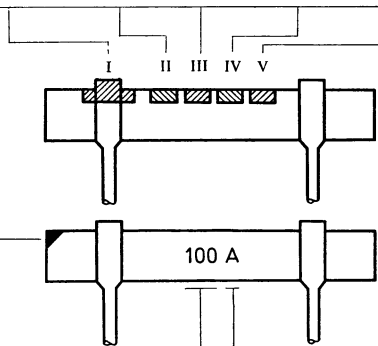


Figure code
colour code for temp. coefficient, see Table above

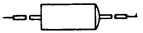
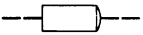
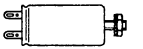
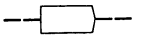
capacitance value in pF, using K for the thousands

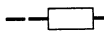
code for tolerance on capacitance:

$C \leqslant 10$ *pF* *tol* (*pF*)	*code*	$C > 10$ *pF* *tol* (%)	*code*
0.25	N	1	D
0.5	L	2	C
1	M	5	B
		10	A

PAPER CAPACITORS AND FILM CAPACITORS

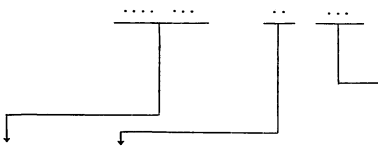
PETP = polyethyleneterephthalate

type	*basic catalogue number*	*dielectric*	*capacitance range*	*rated voltage*
Polyester capacitors				
 interference suppression, single section	2222 276	paper/polyester film	4.7 to 220 nF	250 V r.m.s.
 for fly-back purposes	2222 278	paper/polypropylene	10 to 27 nF 1,5 to 12 nF	750 V (max. permissible peak voltage) 1500 V (max. permissible peak voltage)
 a.c. capacitors	2222 325 2222 326 2222 327	metallised polycarbonate	2 to 25 μF 1,5 to 18 μF 1,5 to 10 μF	160 V r.m.s. 220 V r.m.s. 250 V r.m.s.
"tubular foil"	2222 311	PETP	0,01 to 1 μF 0,001 to 947 μF	160 V d.c. 400 V d.c.
		metallised PETP or metallised polycarbonate	0,068 to 5,6 μF	100 V d.c.
moulded ("mepolesco")	2222 341	metallised PETP	0,010 to 2,2 μF	250 V d.c.
		metallised polycarbonate	0,010 to 1,0 μF 0,010 to 0,47 μF 0,010 to 0,15 μF 0,001 to 0,068 μF	400 V d.c. 630 V d.c. 1000 V d.c. 1600 V d.c.
metallised ("flat film")	2222 342	metallised PETP	0,1 to 6,8 μF 0,01 to 2,2 μF 0,01 to 1 μF 0,01 to 0,47 μF	100 V d.c. 250 V d.c. 400 V d.c. 630 V d.c.

type	*basic catalogue number*	*dielectric*	*capacitance range*	*rated voltage*
	2222 344	metallised PETP metallised poly-carbonate	0,068 to 6,8 μF	100 V d.c.
moulded ("nugget")		metallised PETP	0,01 to 2,2 μF	250 V d.c.
		metallised polycarbonate	0,01 to 1 μF 0,01 to 0,47 μF	400 V d.c. 630 V d.c.
	2222 347	PETP	0,015 to 1 μF 0,010 to 0,68 μF 0,0047 to 0,33 μF 0,002 to 0,22 μF	100 V d.c. 250 V d.c. 400 V d.c. 630 V d.c.
film/foil ("p.p.c.")				
Polystyrene capacitors				
	2222 424 2222 425	polystyrene	1100 to 6800 pF 560 to 3900 pF 330 to 2200 pF	63 V d.c. 125 V d.c. 250 V d.c.
miniature ("micropoco")	2222 426 2222 427		51 to 1200 pF	500 V d.c.
	2222 435 2222 436 2222 437	polystyrene	7,5 to 160 nF 4,3 to 82 nF 2,4 to 47 nF	63 V d.c. 125 V d.c. 250 V d.c.
tubular moulded ("minipoco")	2222 438		1,3 to 24 nF	400 V d.c.

PAPER/FILM CAPACITORS

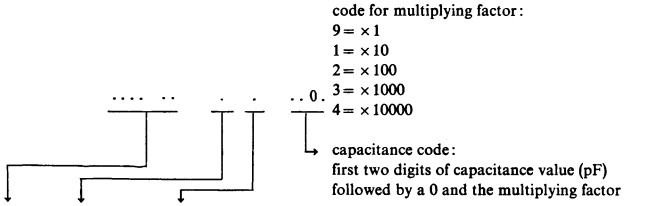
Composition of the catalogue number (for ordering)


code for multiplying factor:
2 = × 0,0001
3 = × 0,001
4 = × 0,01
5 = × 0,1
6 = × 1
capacitance code:
first 2 digits of capacitance volume (μF)
followed by multiplying factor

basic catalogue number	*version code*	*capacitance range (μF)*	*series*	*colour coding*
2222 278	52 = 750 V 72 = 1500 V	0,010 to 0,027 0,0015 to 0,012	E24	—
2222 311	31 = 160 V, 10% 51 = 400 V, 10%	0,01 to 1 0,001 to 0,47	E6	—
2222 341	polycarbonate, tolerance			
	28 = 100 V, 20% 29 = 100 V, 10%	0,068 to 4,7		
	58 = 400 V, 20% 59 = 400 V, 10%	0,010 to 1,0		
	60 = 630 V, 20% 61 = 630 V, 10%	0,010 to 0,47	E6	—
	70 = 1000 V, 20% 71 = 1000 V, 10%	0,010 to 0,15		
	80 = 1600 V, 20% 81 = 1600 V, 10%	0,001 to 0,068		
	PETP,			
	26 = 100 V, 20% 27 = 100 V, 10%	0,068 to 5,6		
	88 = 250 V, 20% 89 = 250 V, 10%	0,010 to 2,2		

basic catalogue number	*version code*	*capacitance range (μF)*	*series*	*colour coding*
2222 342	24 = 100 V, 20% 25 = 100 V, 10%	0,1 to 6,8	E6	see colour code table
	44 = 250 V, 20% 45 = 250 V, 10%	0,01 to 2,2		
	54 = 400 V, 20% 55 = 400 V, 10%	0,01 to 1		
	64 = 630 V, 20% 65 = 630 V, 10%	0,01 to 0,47		
2222 344	polycarbonate,			
	20 = 100 V, 20% 21 = 100 V, 10%	0,068 to 6,8	E6	—
	50 = 400 V, 20% 51 = 400 V, 10%	0,01 to 1		
	60 = 630 V, 20% 61 = 630 V, 10%	0,01 to 0,47		
	PETP.			
	24 = 100 V, 20% 25 = 100 V, 10%	0,068 to 6,8		
	40 = 250 V, 20% 41 = 250 V, 10%	0,01 to 2,2		
2222 347	20 = 100 V, 20% 21 = 100 V, 10%	0,015 to 1	E6	—
	40 = 250 V, 20% 41 = 250 V, 10%	0,010 to 0,68		
	50 = 400 V, 20% 51 = 400 V, 10%	0,0047 to 0,33		
	60 = 630 V, 20% 61 = 630 V, 10%	0,0022 to 0,22		

PAPER/FILM CAPACITORS


code for multiplying factor:
9 = × 1
1 = × 10
2 = × 100
3 = × 1000
4 = × 10000
.... 0 .
capacitance code:
first two digits of capacitance value (pF)
followed by a 0 and the multiplying factor

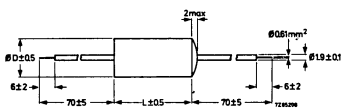
basic catalogue	*voltage code*	*tolerance code*		*capacitance range (pF)*	*series*	*style*
		style A	*style B*			
2222 42	4 = 63 V	2 = 5%	6 = 5%	1100 to 6800 (63 V)		
	5 = 125 V	3 = 2%	7 = 2%	560 to 3900 (125 V)	E24	style A
	6 = 250 V	4 = 1%	8 = 1%	330 to 2200 (250 V)		
	7 = 500 V			51 to 1200 (500 V)		style B
2222 43	5 = 63 V	2 = 5%		7500 to 160 000 (63 V)		
	6 = 125 V	3 = 2%		4300 to 82 000 (125 V)	E24	
	7 = 250 V	4 = 1%		2400 to 47 000 (250 V)		
	8 = 500 V			1300 to 24 000 (500 V)		

Composition of the catalogue number (for ordering)

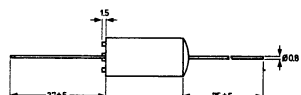
2222 276 . . . . .

suffix code see table

	nominal capacitance (nF)	*dimensions (mm)* *D*	*L*	*suffix code* *type A*	*type B*
safety version	4.7	13	25	—	60101
version for domestic apparatus	10	13	25	00003	10003
	15	13	25	00004	10004
	22	13	25	00005	10005
	33	13	25	00006	10006
	47	13	25	00007	10007
	68	13	25	00008	10008
	100	13	31	00009	10009
version for apparatus with extended service life	6,8	13	25	40002	60002
	10	13	25	40003	60003
	15	13	25	40004	60004
	22	13	25	40005	60005
	33	13	25	40006	60006
	47	13	31	40007	60007
	68	16	36	40008	60008
	100	16	36	40009	60009
	150	18	36	40011	60011
	220	20	41	40012	60012



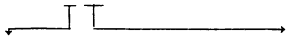
type A



type B

PAPER/FILM CAPACITORS

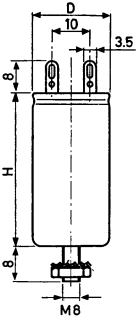
2222 325 . . . . .
326 . . . . .
327 . . . . .

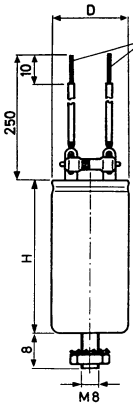


50 = version A
52 = version B
70 = version C

capacitance (μF)	*dimensions D × H (mm)*			*suffix code*
	325 *series*	326-*series*	327-*series*	
1.5				155
2				205
2.5			30 × 40	255
3		30 × 40		305
3.5				355
4	30 × 40			405
4.5			30 × 52	455
5				505
6				605
7			35 × 52	705
8		30 × 52		805
9				905
10	30 × 52		40 × 52	106
12		35 × 52		126
14				146
16	35 × 52	40 × 52		166
18				186
20				206
25	40 × 52			256

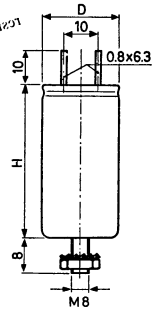
Version A
capacitors with
soldering tags



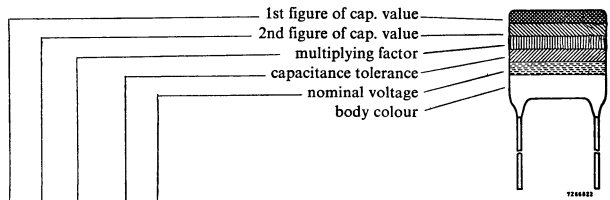


Version B
capacitors with leads
and discharging

Version C
capacitors with
flat connections



Colour code for 2222 342

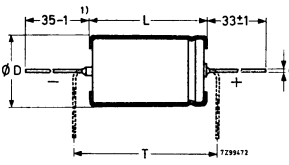


colour					
black	–	0	1	±20%	
brown	1	1	10		100 V
red	2	2	10^2		250 V
orange	3	3	10^3		
yellow	4	4	10^4		400 V
green	5	5	10^5		
blue	6	6			630 V
violet	7	7			
grey	8	8			
white	9	9		±10%	

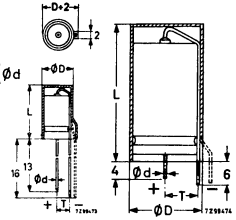
ELECTROLYTIC CAPACITORS

Miniature and small types for general purposes

style	*case size*	*IEC 68 category*	*IEC 103 type*	*capac. tol.* (%)
1 and 2	1	25/070/56	2	−10/+100
1 and 2	2, 3 and 5a	25/085/56	2	−10/+50
1 and 3	4, 5 and 6	40/085/56	1	−10/+50
1, 3 and 4	00 to 03	40/085/56	1	−10/+50

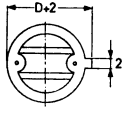


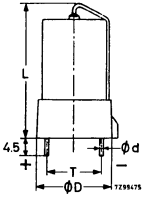
Style 1



Style 2 Style 3

case size		*style* 1			*style* 2			*style* 3			*style* 4		
	d (*mm*)	*D* (*mm*) *max.*	*L* (*mm*) *max.*	*T* [2]	*D* (*mm*) *max.*	*L* (*mm*) *max.*	*T* [2]	*D* (*mm*) *max.*	*L* (*mm*) *max.*	*T* [2]	*D* (*mm*) *max.*	*L* (*mm*) *max.*	*T* [2]
1	0.6	3.5	10.5	6E	4.1	12.5	E						
2	0.6	4.8	12.5	6E	5.6	14.5	E						
3	0.6	6.1	12.5	6E	6.9	14.5	E$\sqrt{2}$						
5a	0.6	8.3	13.5	6E	9.1	14.5	2E						
4	0.6	6.7	20	10E				8.5	24.5	2E			
5	0.6	8.3	20	10E				10.2	24.5	2E			
6	0.6	10.3	20	10E				12.1	24.5	3E			
00	0.8	10.4	32.5	14E				11.2	34.5	3E	12.8	41	4E
01	0.8	12.9	32.5	14E				13.6	34.5	3E	15.2	41	4E
02	0.8	15.4	32.5	14E				16	34.5	4E	17.8	41	5E
03	0.8	18.4	32.5	14E				19	34.5	4E	20.8	41	6E





Style 4

[1]) 55 − 1 for case sizes 00, 01, 02 and 0.3 [2]) E = 2.5 + 0.04 mm.

U_R (V)	capacitance at 100 Hz (μF)	case size	catalog number 2222 followed by		
			style 1	styles 2+3	style 4
4	15	1	015 12159	015 42159	
4	47	2	015 12479	015 42479	
4	100	3	015 12101	015 42101	
4	220	5a	015 12221	015 42221	
4	220	4	016 12221	016 42221	
4	330	5	016 12331	016 42331	
4	1000	00	017 12102	017 42102	017 52102
4	4700	03	017 12472	017 42472	017 52472
6.3	10	1	015 13109	015 43109	
6.3	33	2	015 13339	015 43339	
6.3	68	3	015 13689	015 43689	
6.3	150	5a	015 13151	015 43151	
6.3	150	4	016 13151	016 43151	
6.3	470	6	016 13471	016 43471	
6.3	680	00	017 13681	017 43681	017 53681
6.3	1500	01	017 13152	017 43152	017 53152
6.3	2200	02	017 13222	017 43222	017 53222
6.3	3300	03	017 13332	017 43332	017 53332
10	6.8	1	015 14688	015 44688	
10	22	2	015 14229	015 44229	
10	47	3	015 14479	015 44479	
10	100	5a	015 14101	015 44101	
10	100	4	016 14101	016 44101	
10	220	5	016 14221	016 44221	
10	330	6	016 14331	016 44331	
10	470	00	017 14471	017 44471	017 54471
10	1000	01	017 14102	017 44102	017 54102
10	1500	02	017 14152	017 44152	017 54152
10	2200	03	017 14222	017 44222	017 54222

ELECTROLYTIC CAPACITORS

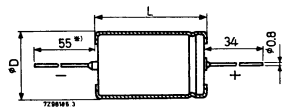
U_R (V)	capacitance at 100 Hz (μF)	case size	catalog number 2222 followed by		
			style 1	styles 2 + 3	style 4
16	4.7	1	015 15478	015 45478	
16	15	2	015 15159	015 45159	
16	33	3	015 15339	015 45339	
16	68	5a	015 15689	015 45689	
16	68	4	016 15689	016 45689	
16	150	5	016 15151	016 45151	
16	220	6	016 15221	016 45221	
16	330	00	017 15331	017 45331	017 55331
16	680	01	017 15681	017 45681	017 55681
16	1000	02	017 15102	017 45102	017 55102
16	1500	03	017 15152	017 45152	017 55152
25	3.3	1	015 16338	015 46338	
25	10	2	015 16109	015 46109	
25	22	3	015 16229	015 46229	
25	47	5a	015 16479	015 46479	
25	47	4	016 16479	016 46479	
25	100	5	016 16101	016 46101	
25	150	6	016 16151	016 46151	
25	220	00	017 16221	017 46221	017 56221
25	470	01	017 16471	017 46471	017 56471
25	680	02	017 16681	017 46681	017 56681
25	1000	03	017 16102	017 46102	017 56102
40	2.2	1	015 17228	015 47228	
40	6.8	2	015 17688	015 47688	
40	15	3	015 17159	015 47159	
40	33	5a	015 17339	015 47339	
40	33	4	016 17339	016 47339	
40	47	5	016 17479	016 47479	
40	100	6	016 17101	016 47101	
40	150	00	017 17151	017 47151	017 57151
40	220	01	017 17221	017 47221	017 57221
40	470	02	017 17471	017 47471	017 57471
40	680	03	017 17681	017 47681	017 57681

U_R (V)	capacitance at 100 Hz (μF)	case size	catalog number 2222 followed by		
			style 1	styles 2+3	style 4
63	0.47	3	015 18477	015 48477	
63	0.47	4	016 18477	016 48477	
63	1	3	015 18108	015 48108	
63	1	4	016 18108	016 48108	
63	1.5	1	015 18158	015 48158	
63	1.5	3	015 90001	015 90002	
63	2.2	3	015 18228	015 48228	
63	2.2	4	016 18228	016 48228	
63	3.3	3	015 18338	015 48338	
63	4.7	3	015 90003	015 90004	
63	4.7	2	015 18478	015 48478	
63	4.7	4	016 18478	016 48478	
63	6.8	3	015 18688	015 48688	
63	10	3	015 18109	015 48109	
63	10	4	016 18109	016 48109	
63	15	5a	015 18159	015 48159	
63	15	4	016 18159	016 48159	
63	22	5	016 18229	016 48229	
63	47	6	016 18479	016 48479	
63	68	00	017 18689	017 48689	017 58689
63	100	01	017 18101	017 48101	017 58101
63	150	01	017 18151	017 48151	017 58151
63	220	02	017 18221	017 48221	017 58221
63	330	03	017 18331	017 48331	017 58331

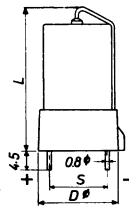
ELECTROLYTIC CAPACITORS

Small type for high voltages

can size	*axial version*		*printed-wiring version*		
	D (*mm*)	*L* (*mm*)	*D* (*mm*)	*L* (*mm*)	*S* (*mm*)
0	10.4	18.5	12.8	26	10.16
00	10.4	30.5	12.8	39.3	10.16
01	12.9	30.5	15.2	39.3	10.16
02	15.4	30.5	17.8	39.3	12.70
03	18.5	30.5	20.8	39.3	15.24



Axial version
(insulated)



Printed-wiring
version

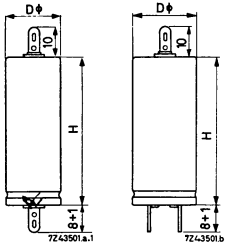
*) 35 mm for can size 00

Temperature range: −40 to +70°C
Tolerance on capacitance: −10 to +30%
Catalog number: 2222 040 1 . . . ., axial version
2222 040 4 . . . ., printed-wiring version

can size	*working voltage* ($V_{d.c.}$)	*capac-itance* (μF)	*catalog number suffix*
00	100	20	0209
01	100	32	0329
02	100	50	0509
03	100	80	0809
0	150	6.4	1648
00	150	12.5	1139
01	150	20	1209
02	150	32	1329
03	150	50	1509
00	200	10	2109
01	200	16	2169
02	200	25	2259
03	200	40	2409
0	250	4	3408
00	250	8	3808
01	250	12.5	3139
02	250	20	3209
03	250	32	3329
00	300	6.4	4648
01	300	10	4109
02	300	16	4169
03	300	25	4259
0	350	2.5	5258
00	350	5	5508
01	350	8	5808
02	350	12.5	5139
03	350	20	5209
00	400	4	6408
01	400	6.4	6648
02	400	10	6109
03	400	16	6169

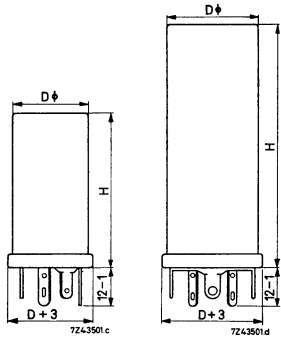
ELECTROLYTIC CAPACITORS

Large types for high and low voltages



Can sizes 4, 5, 6 — Can sizes 3, 4, 5, 6

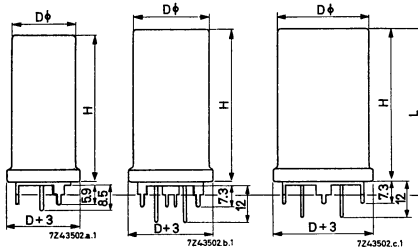
Capacitors with soldering terminals



Can sizes 6T, 7 — Can sizes 8, 9

Capacitors with twistable mounting lugs

case size	*D (mm)*	*H (mm)*	*L*
3	19	34	36
4	19	50	52
5	22	50	52
6	26	50	
6T	26	52	55
7	26	81	
8	31	81	
8A	31	52	55
9	36	81	
9A	36	52	55



Can sizes 4, 5 — Can size 6T — Can sizes 8A, 9A

Capacitors for printed-wiring boards

Temperature range: −40 to +70°C
Tolerance on capacitance
6.4– 64 V types: −10 to +50%
100–500 V types: −10 to +30%
Catalog number: 2222 . . . . . .

Capacitors with soldering terminals

Single capacitors

can size	*working voltage* ($V_{d.c.}$)	*capacitance* (μF)	*catalog number suffix*
4	10	1250	063 14132
5	10	2000	202
6	10	3200	322
4	16	800	063 15801
6	16	2000	202
4	25	500	063 16501
5	25	800	801
6	25	1250	132
5	40	500	063 17501
5	64	320	063 18321
6	64	500	501

can size	*working voltage* ($V_{d.c.}$)	*capacitance* (μF)	*catalog number suffix*
4	100	100	080 10101
6	100	250	251
4	150	64	080 11649
5	150	100	101
6	300	100	080 14101
4	350	32	080 15329
5	350	50	509
5	400	32	080 16329
6	400	50	509
5	500	25	080 18259
6	500	32	329

Double capacitors

can size	*working voltage* ($V_{d.c.}$)	*capacitance* (μF)	*catalog number suffix*
4	25	250+250	064 16251
4	64	100+100	064 18101
3	100	25+25	081 10259
4	100	50+50	509
5	150	50+50	081 11509

can size	*working voltage* ($V_{d.c.}$)	*capacitance* (μF)	*catalog number suffix*
6	300	50+50	081 14509
5	350	25+25	081 15259
6	350	32+32	081 18329
4	500	8+8	081 18808

ELECTROLYTIC CAPACITORS

Capacitors with twistable mounting lugs
Single capacitors

can size	*working voltage* ($V_{d.c.}$)	*capac-itance* (μF)	*catalog number suffix*	*can size*	*working voltage* ($V_{d.c.}$)	*capac-itance* (μF)	*catalog number suffix*
7	25	2000	063 36202	8	150	500	080 31501
8	25	2500	252	8	300	250	080 34251
6T	40	800	063 37801	9	350	250	080 35251
7	40	1250	132	7	400	100	080 36101
8	40	1600	162	8	450	100	080 37101
8	64	1000	063 38102	7	500	50	080 38509
6T	100	250	080 30251	9	500	100	101

Double capacitors

can size	*working voltage* ($V_{d.c.}$)	*capac-itance* (μF)	*catalog number suffix*	*can size*	*working voltage* ($V_{d.c.}$)	*capac-itance* (μF)	*catalog number suffix*
6T	25	640+640	064 36641	6T	350	32+32	081 35329
6T	64	250+250	064 38251	9	350	125+125	131
8	64	500+500	501	6T	400	25+25	081 36259
6T	100	125+125	081 30131	7	400	50+50	509
6T	150	125+125	081 31131	8	450	50+50	081 37509
8	150	250+250	251	6T	500	16+16	081 38169
6T	300	50+50	081 34509	7	500	25+25	259
8	300	125+125	031	9	500	50+50	509

Single capacitors

can size	*working voltage* ($V_{d.c.}$)	*capac-itance* (μF)	*catalog number suffix*
5	10	2000	063 54202
4	16	800	063 55801
5	16	1250	132
6T	16	2000	063 55202
8A	16	3200	322
9A	16	4000	402
4	25	500	063 56501
5	25	800	801
6T	25	1250	132
8A	25	2000	202
9A	25	2500	252
4	40	320	063 57321
5	40	500	501
6T	40	800	801
8A	40	1250	132
9A	40	1600	162
5	64	320	063 58321
6T	64	500	501
8A	64	800	801
9A	64	1000	102
4	150	64	080 51649
5	150	100	101
9A	200	250	080 52251
6T	300	100	080 54101
4	350	32	080 55329
5	350	50	509
6T	400	50	080 56509
8A	450	64	080 57649
4	500	16	080 58169
8A	500	50	509

Double capacitors

can size	*working voltage* ($V_{d.c.}$)	*capac-itance* (μF)	*catalog number suffix*
8A	25	1000 + 1000	064 56102
6T	64	250 + 250	064 58251
8A	64	400 + 400	401
6T	250	50 + 50	081 53509
6T	300	50 + 50	081 54509
5	350	25 + 25	081 55259
6T	350	32 + 32	329
8A	400	50 + 50	081 55509
6T	500	16 + 16	081 58169

ELECTROLYTIC CAPACITORS

Multiple types for high voltages

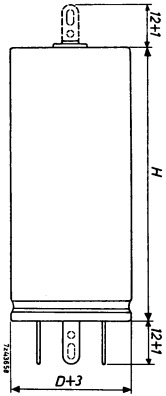


Fig. 1

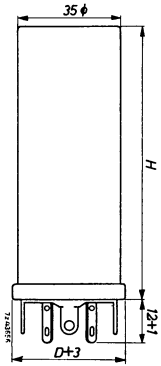


Fig. 2

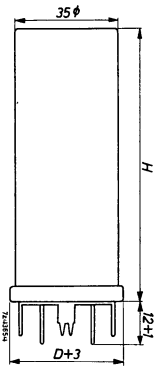


Fig. 3

capacitance (μF)	*max. voltage* ($V_{d.c.}$)	*Fig.*	*D* (*mm*)	*H* (*mm*)	*cat. number* 2222 ... .
50 + 50 + 50	350	2	35	80	063 90027
100 + 50 + 50	300	2	35	80	063 90022
100 + 100 + 50	300	2	35	80	067 90003
200 + 100 + 50 + 25	300	1	35	80	067 90012
200 + 100 + 50 + 25	300	2	35	80	067 90013
200 + 100 + 50 + 25	300	3	35	80	067 90014

Large long life type (I.E.C. type 1)

Fig.	*can size*	*D* (*mm*)	*L* (*mm*)	*t* (*mm*)
1	5	21.3	49.3	12
1	6	25.3	49.3	12
1	7	25.3	80.3	12
1	8a	30.3	50.3	12
1	8	30.3	80.3	12
2	9a	35.3	50.3	12
2	9	35.3	80.3	12
2	10	40.5	80.3	12

Temperature range: -40 to $+85°C$
Tolerance on capacitance: -10 to $+50\%$
Catalogue numbers: 2222 071 ....., 2222 072 ....., 2222 073 .....
Max (d.c. + peak a.c.) voltage at $\leqslant 40°C$: 1.1 × rated voltage

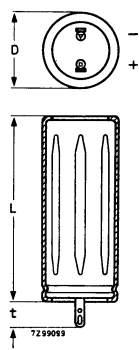


Fig. 1
(single)

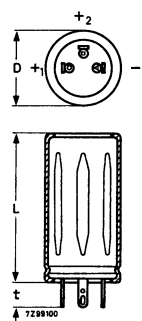


Fig. 2
(double)

ELECTROLYTIC CAPACITORS

can size	*rated voltage (V)*	*capacitance (μF)*	*catal. No. 2222 followed by*
6	6.3	10000	071 13103
7	6.3	15000	071 13153
8a	6.3	15000	073 13153
8	6.3	22000	071 13223
9a	6.3	11000 + 11000	072 13113
9	6.3	16500 + 16500	072 13173
10	6.3	23500 + 23500	072 13243
5	10	4700	071 14472
6	10	6800	071 14682
7	10	10000	071 14103
8a	10	10000	073 14103
8	10	15000	071 14153
9a	10	7500 + 7500	072 14752
9	10	11000 + 11000	072 14113
10	10	16500 + 16500	072 14173
5	16	3300	071 15332
6	16	4700	071 15472
7	16	6800	071 15682
8a	16	6800	073 15682
8	16	10000	071 15103
9a	16	5000 + 5000	072 15502
9	16	7500 + 7500	072 15752
10	16	11000 + 11000	072 15113

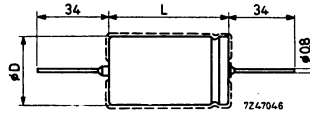
can size	*rated voltage (V)*	*capacitance (μF)*	*catal. No. 2222 followed by*
5	25	2200	071 16222
6	25	3300	071 16332
7	25	4700	071 16472
8a	25	4700	073 16472
8	25	6800	071 16682
9a	25	3400 + 3400	072 16342
9	25	5000 + 5000	072 16502
10	25	7500 + 7500	072 16752
5	40	1000	071 17102
6	40	2200	071 17222
7	40	3300	071 17332
8a	40	3300	073 17332
8	40	4700	071 17472
9a	40	2350 + 2350	072 17242
9	40	3400 + 3400	072 17342
10	40	5000 + 5000	072 17502
5	63	680	071 18681
6	63	1000	071 18102
7	63	1500	071 18152
8a	63	1500	073 18152
8	63	2200	071 18222
9a	63	1100 + 1100	072 18112
9	63	1650 + 1650	072 18172
10	63	2350 + 2350	072 18242

Mounting clamps for 071, 072 *and* 073 *series*

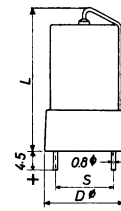
can size	*catalog number*
5	4322 043 03290
6.7	03300
8, 8a	03310
9, 9a	04272
10	03330

Small long life type

can size	*axial version*		*printed-wiring version*		
	D (*mm*)	*L* (*mm*)	*D* (*mm*)	*L* (*mm*)	*S* (*mm*)
1	8.3	22.5	11.3	30	10.16
2	10.5	22.5	12.9	31	10.16
3	10.5	30.5	12.9	39	10.16
4	13	30.5	15.3	39	10.16



Axial version



Printed-wiring version

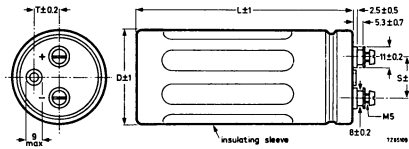
Temperature range: −40 to +70°C
Tolerance on capacitance: −10 to +50%
Catalog number: 2222 101 1 . . . ., axial version
2222 101 4 . . . ., printed-wiring version

can size	*working voltage* ($V_{d.c.}$)	*capac-itance* (*μF*)	*catalog number suffix*
1	4	25	2259
1	4	50	2509
2	4	80	2809
3	4	160	2161
4	4	320	2321
1	6.4	20	3209
1	6.4	40	3409
2	6.4	64	3649
3	6.4	125	3131
4	6.4	250	3251
1	10	16	4169
1	10	32	4329
2	10	50	4509
3	10	100	4101
4	10	200	4201
1	16	10	5109
1	16	20	5209
2	16	32	5329
3	16	64	5649
4	16	125	5131
1	25	6.4	6648
1	25	12.5	6139
2	25	20	6209
3	25	40	6409
4	25	80	6809
1	40	4	7408
1	40	8	7808
2	40	12.5	7139
3	40	25	7259
4	40	50	7509
1	64	2.5	8258
1	64	5	8508
2	64	8	8808
3	64	16	8169
4	64	32	8329

ELECTROLYTIC CAPACITORS

Large long life type (I.E.C. type 1)

can size	$D_{max.}$ (*mm*)	*L* (*mm*)	*S* (*mm*)
11	35.8	82	15
12	35.8	114	15
14	50.8	82	22
15	50.8	114	22
16	65.8	114	31



Temperature range: -40 to $+70°C$
Tolerance on capacitance: -10 to $+50\%$
Catalog number: 2222 106 . . . . ., working voltage 6.3 to 63 $V_{d.c.}$
2222 107 . . . . ., working voltage 100 $V_{d.c.}$

Mounting clamps for 106 *and* 107 *series*

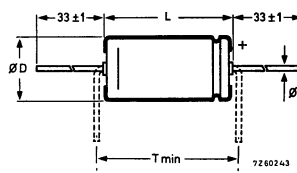
For cans with 35 mm dia.: 4322 043 04271
50 mm dia.: 04280
65 mm dia.: 04290

can size	*rated voltage (V)*	*capac-itance (μF)*	*cat. number 2222 followed by*
11	6.3	22000	106 13223
12	6.3	33000	106 13333
14	6.3	47000	106 13473
15	6.3	68000	106 13683
16	6.3	150000	106 13154
11	10	15000	106 14153
12	10	22000	106 14223
14	10	33000	106 14333
15	10	47000	106 14473
16	10	100000	106 14104
11	16	10000	106 15103
12	16	15000	106 15153
14	16	22000	106 15223 [1]
15	16	3300	106 15333
16	16	68000	106 15683
11	25	6800	106 16682
12	25	10000	106 16103
14	25	15000	106 16153
15	25	22000	106 16223
16	25	47000	106 16473
11	40	4700	106 17472
12	40	6800	106 17682
14	40	10000	106 17103
15	40	15000	106 17153
16	40	33000	106 17333 [1]
11	63	2200	106 18222
12	63	3300	106 18332
14	63	4700	106 18472
15	63	6800	106 18682
16	63	15000	106 18153
11	100	1500	107 10152
12	100	2200	107 10222
14	100	3300	107 10332
15	100	4700	107 10472
16	100	10000	107 10103

[1]) For capacitors provided with bolt and nut the 8th digit in the catalog number is 5 instead of 1.
Note: Mounting position not with terminals down.

Solid aluminium type

case size	D_{max} *(mm)*	L^{-1} *(mm)*	T_{min} [1])
1	6.6	17.5	8e
2	6.6	24	11e
3	8.3	24	11e
4	10.4	24	11e
5	10.4	32	14e
6	12.9	32	14e



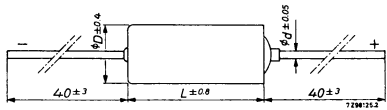
e = 2.50 + 0.04 mm
Temperature range −55 to +85°C
Tolerance on capacitance ±20%
Catalog number 2222 121 .....

ELECTROLYTIC CAPACITORS

case size	*rated voltage* ($V_{d.c.}$)	*capac-itance* (μF)	*catalog number suffix*
1	6.3	22	13229
2	6.3	47	13479
3	6.3	68	13689
4	6.3	150	13151
5	6.3	220	13221
6	6.3	330	13331
1	10	15	14159
2	10	33	14339
3	10	47	14479
4	10	100	14101
5	10	150	14151
6	10	220	14221
1	16	10	15109
2	16	15	15159
3	16	33	15339
4	16	47	15479
5	16	68	15689
6	16	100	15101
1	25	4.7	16478
2	25	10	16109
3	25	22	16229
4	25	33	16339
5	25	47	16479
6	25	68	16689
1	40	2.2	17228
2	40	4.7	17478
3	40	10	17109
4	40	22	17229
5	40	33	17339
6	40	47	17479

Solid tantalum type

case size	*D* (*mm*)	*L* (*mm*)	*d* (*mm*)
1	3.43	7.26	0.51
2	4.75	12.04	0.51
3	7.34	17.42	0.64
4	8.92	19.96	0.64



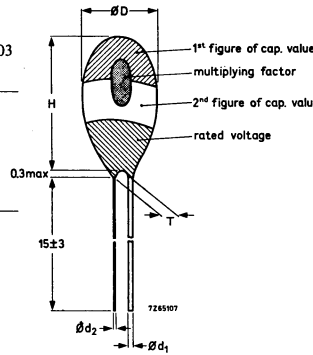
Temperature range: −55 to +85°C
Tolerance on capacitance: ±20%
Catalog number: 2222 143 .....

can size	*d.c. rated voltage at 85°C (V)*	*capacitance (μF)*	*catalog number suffix*
1	6	5.6	13568
1	6	6.8	13688
2	6	47	13479
2	6	56	13569
3	6	150	13151
3	6	180	13181
4	6	270	13271
4	6	330	13331
1	10	3.9	14398
1	10	4.7	14478
2	10	27	14279
2	10	33	14339
2	10	39	14399
3	10	82	14829
3	10	100	14101
3	10	120	14121
4	10	180	14181
4	10	220	14221
1	15	2.7	15278
1	15	3.3	15338
2	15	18	15189
2	15	22	15229
3	15	56	15569
3	15	68	15689
4	15	120	15121
4	15	150	15151
1	20	1.2	16128
1	20	1.5	16158
1	20	1.8	16188
1	20	2.2	16228
2	20	8.2	16828
2	20	10	16109
2	20	12	16129
2	20	15	16159
3	20	27	16279
3	20	33	16339
3	20	39	16399
3	20	47	16479
4	20	56	16569
4	20	68	16689
4	20	82	16829
4	20	100	16101
1	35	0.33	17337
1	35	0.39	17397
1	35	0.47	17477
1	35	0.56	17567
1	35	0.68	17687
1	35	0.82	17827
1	35	1	17108
2	35	1.2	17128
2	35	1.5	17158
2	35	1.8	17188
2	35	2.2	17228
2	35	2.7	17278
2	35	3.3	17338
2	35	3.9	17398
2	35	4.7	17478
2	35	5.6	17568
2	35	6.8	17688
3	35	8.2	17828
3	35	10	17109
3	35	12	17129
3	35	15	17159
3	35	18	17189
3	35	22	17229
4	35	27	17279
4	35	33	17339
4	35	39	17399
4	35	47	17479

ELECTROLYTIC CAPACITORS

Solid tantalum type

Size	*Dmax* (*mm*)	*Hmax* (*mm*)	$T \pm 0.3$ (*mm*)	$d_1 \pm 0.05$ (*mm*)	$d_2 \pm 0.03$ (*mm*)
DTM1	2	2.7	1	0.3	0.2
DTM2	2	4	1	0.3	0.2
DTM3	2.5	4.2	1	0.3	0.2
DTM4	3.2	4.5	1.1	0.3	0.2
DTM5	4	7.5	1.2	0.3	0.2

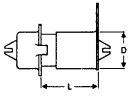
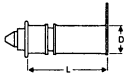
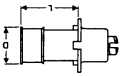
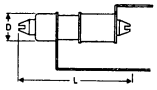


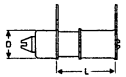
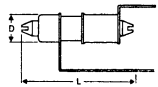
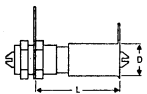
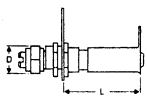
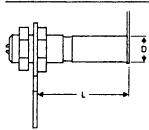
Temperature range -55 to $+85°C$
Tolerance on capacitance $\pm 20\%$
Catalog number 2222 146 .....

colour	*capacitance* (μF)		*multiplying factor* (*spot*)	*rated voltage* (*V*) (*third band*)
	1*st figure* (*first band*)	2*nd figure* (*second band*)		
black	—	0	1	10
brown	1	1	10	1.6
red	2	2	10^2	4
orange	3	3		40
yellow	4	4		6.3
green	5	5		16
blue	6	6		—
violet	7	7	10^{-3}	
grey	8	8	10^{-2}	25
white	9	9	10^{-1}	2.5

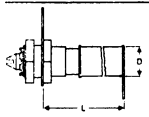
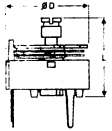
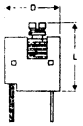
rated voltage (V)	*nom. cap. at 100 Hz (μF)*	*size*	*cat. number 2222 146 ....*
1.6	1.5	1	10158
1.6	2.2	1	10228
1.6	3.3	2	10338
1.6	4.7	2	10478
1.6	6.8	3	10688
1.6	10	3	10109
1.6	15	4	10159
1.6	22	4	10229
1.6	47	5	10479
1.6	68	5	10689
2.5	1	1	11108
2.5	2.2	2	11228
2.5	4.7	3	11478
2.5	10	4	11109
2.5	33	5	11339
4	0.68	1	12687
4	1.5	2	12158
4	3.3	3	12338
4	6.8	4	12688
4	22	5	12229
6.3	0.47	1	13477
6.3	1	2	13108
6.3	2.2	3	13228
6.3	4.7	4	13478
6.3	15	5	13159
10	0.33	1	14337
10	0.68	2	14687
10	1.5	3	14158
10	3.3	4	14338
10	10	5	14109
16	0.22	1	15227
16	0.47	2	15477
16	1	3	15108
16	2.2	4	15228
16	6.8	5	15688
25	0.15	1	16157
25	0.33	2	16337
25	0.68	3	16687
25	1.5	4	16158
25	4.7	5	16478
40	0.01	1	17106
40	0.015	1	17156
40	0.022	1	17226
40	0.033	1	17336
40	0.047	1	17476
40	0.068	1	17686
40	0.1	1	17107
40	0.15	2	17157
40	0.22	2	17227
40	0.33	3	17337
40	0.47	3	17477
40	0.68	4	17687
40	1	4	17108
40	1.5	5	17158
40	2.2	5	17228
40	3.3	5	17338

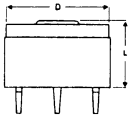
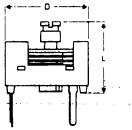
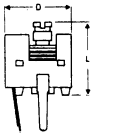
VARIABLE CAPACITORS

model		*catalogue number*	*capacitance max C min/ min C max (pF)*	*rated voltage (V d.c.)*	*temperature coefficient (ppm/deg C)*	*temperature range (°C)*	*dimensions L × D (mm)*
Tubular ceramic capacitors	type B	2222 801 20001	0,8/3				5,5 × 6
		20002	0,8/6				8,5 × 6
		20003	0,9/9				11,5 × 6
		20004	1 /12	500	− 200 ± 200	− 50 to + 100	14,5 × 6
	type A	20005	0,8/3				5,5 × 6
		20006	0,8/6				8,5 × 6
		20007	0,9/9				11,5 × 6
		20008	1 /12				14,5 × 6
 type A type B							
		2222 801 20051	0,8/3	400	− 200 ± 200	− 50 to + 100	8 × 4
		20052	0,8/6		− 300 ± 200		11 × 4
		2222 801 96002	0,7/6	500	+ 150 ± 100	− 50 to + 100	8,5 × 6
		96003	0,5/3		+ 150 ± 150		
		2222 801 96124	0,3/1,5		+ 50 ± 100		13 × 4
		96127	0,5/3,5	400	− 200 ± 200	− 50 to + 100	13 × 4
		96135	1,0/6,0		− 300 ± 300		13 × 4

	2222 801 96138 96139	0,5/3,0 1,0/5,5	400	+150 ±200 +100 ±300	−50 to 100	5 × 4 5 × 4
	2222 801 96122 96128	0,8/ 6 2 /10	500	+150 ±100 +100 ±300	−40 to +85	17,5 × 6
	2222 802 20001 20002 20003 20004 20005	0,8/3 0,8/6 0,9/9 1,0/12 1,7/8	500	−200 ±200	−50 to +100	11 × 6 14 × 6 17 × 6 20 × 6 20 × 6
	2222 802 20011 20012 20013 20014 20015	0,5/3 0,6/4,5 0,7/6 0,9/9 1,0/12	500	−10 ±60 −10 ±60 −10 ±60 −250 ±250 −250 ±250	−50 to +100	12,4 × 6 15,4 × 6 17,9 × 6 15,4 × 6 18,4 × 6
	2222 802 96035 96036	0,8/3 0,8/6	400	−200 ±200 −300 ±200	−50 to +100	8,3 × 4 11,3 × 4

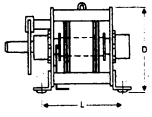
VARIABLE CAPACITORS

model	*catalogue number*	*capacitance max C min/ min C max (pF)*	*rated voltage (V. dc)*	*temperature coefficient (ppm/deg C)*	*temperature range (°C)*	*dimensions L × D (mm)*
	2222 802 960..[2]	0,5/3 to 1,0/12	400 to 500	−10 ±60 to −200 ±150	−50 to +100	8,8 × 4 to 20 × 5,5
Film dielectric capacitors 	2222 808 .....[1]	1,2/3,5 to 5,5/65	100	−200 ±300 to −750 ±300	−40 to +70	10 × 8 to 10,6 × 11
 top adjustment	2222 809 05001	1 /3,5	300	−250 ±150	−40 to +125	9 × 8
	05002	1,8/10		−300 ± 75		
	05003	2 /18		−350 ± 75		
top and bottom adjustment	05004	1 /3,5		−250 ±150		
	05005	1,8/10		−300 ± 75		
	05006	2 /18		−350 ± 75		

	[3] 2222 809 070..	2,5/20 to 7 /100	200 to 350	0 ±200	−40 to +125	9 × 14
	[1] 2222 809 08002 08003	4/40 5/50	300	−250 ±150 −250 ±150	−40 to +125	11 × 11
	2222 809 09001 09002 09003	1,4/5,5 2 /9 2 /18	250	−250 ±150 −250 ±150 −250 ±150	−40 to +125	10 × 9

[1]) Top and bottom adjustment available. More details on request.
[2]) High stability with friction locking device in screw and solder mounting. More details on request.
[3]) Top adjustment only.

VARIABLE CAPACITORS

model	*catalogue number*	*capacitance range (pF)*				*L × D (mm)*		
Precision tunning-capacitors	[1])	*Stator types*	40 × 40 mm *linear*	60 × 60 mm *linear*	*logarithmic*	*number of gangs*	*D* = 40 × 40 *mm*	*D* = 60 × 60 *mm*
	2222 805	single 1–4 gangs	16–250	100–64	100–500	1	L = 45	L = 67
						2	L = 76,5	L = 117,5
						3	L = 108	L = 168
						4	L = 139,5	L = 218,5
		split 1–4 gangs	10– 64	25–125	25–125			
		differential 1 gang	64–160	—	—			

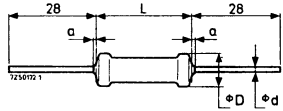
temperature range: −40 to +85°C

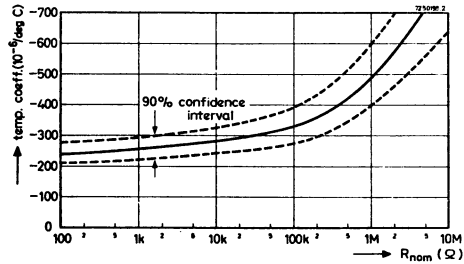
[1]) Complete program available on request.

FIXED RESISTORS

Carbon film resistors

style	$D_{max.}$	$L_{max.}$	$a_{max.}$	d
CR16	1.6	4.5	1.0	0.4
CR25	2.5	7.5	1.0	0.6
CR37	3.7	10	1.0	0.7
CR52	5.2	18	1.2	0.8
CR68	6.8	18	1.2	0.8
[1]) CR93 (5%)	9.3	32	1.2	0.8
CR93 (1%)	9.3	38.5	3.2	1

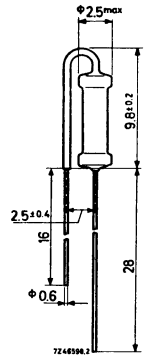




Temperature coefficient as a function of the resistance value, applicable to all resistor styles.

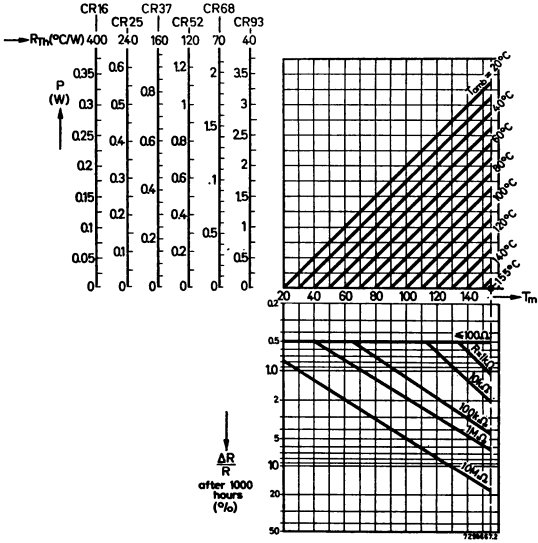
Style CR25A

The bent lead is partly covered with an insulating lacquer having a breakdown voltage of minimum 50 $V_{d.c.}$



[1]) Lead length 36 mm.

Minimum ambient temperature −55°C
Max. hot-spot temperature 155°C



Performance nomogram for the different styles of resistor, showing the relationship between power dissipation P, ambient temperature T_{amb}, hot-spot temperature T_m, resistance value R and max. resistance drift $\Delta R/R$ after 1000 hours operation.

FIXED RESISTORS

Standard range

style	*limiting voltage* V_{rms}	*resistance range*	*tolerance* ±	*series*	*catalog number*
CR16	150	10 Ω–220 kΩ	5%	E24	2322 210 13...
		270 kΩ–1 MΩ	10%	E12	2322 210 12...
CR25	250	1 Ω–1 MΩ	5%	E24	2322 101 33...
		10 Ω–220 kΩ	2%	E24	2322 101 34...
		1.2 MΩ–10 MΩ	10%	E12	2322 101 32...
CR25A	250	1 Ω–1 MΩ	5%	E24	2322 106 33...
		10 Ω–220 kΩ	2%	E24	2322 106 34...
		1.2 MΩ–10 MΩ	10%	E12	2322 106 32...
CR37	350	1 Ω–1 MΩ	5%	E24	2322 212 13...
		10 Ω–1 MΩ	2%	E24	2322 212 14...
		10 Ω–1 MΩ	1%	E24	2322 222 0..0.
		1.2 MΩ–10 MΩ	10%	E12	2322 212 12...
CR52	500	1 Ω–1 MΩ	5%	E24	2322 101 63...
		10 Ω–1 MΩ	1%	E24	2322 223 8..0.
		1.2 MΩ–22 MΩ	10%	E12	2322 101 62...
CR68	750	1 Ω–1.6 MΩ	5%	E24	2322 214 13...
		10 Ω–1.6 MΩ	1%	E24	2322 224 0..0.
		1.8 MΩ–22 MΩ	10%	E12	2322 214 12...
CR93	1000	10 Ω–22 MΩ	5%	E24	2322 215 13...
		10 Ω–1.6 MΩ	1%	E24	2322 225 8..0.

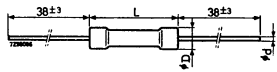
Composition of the catalog number

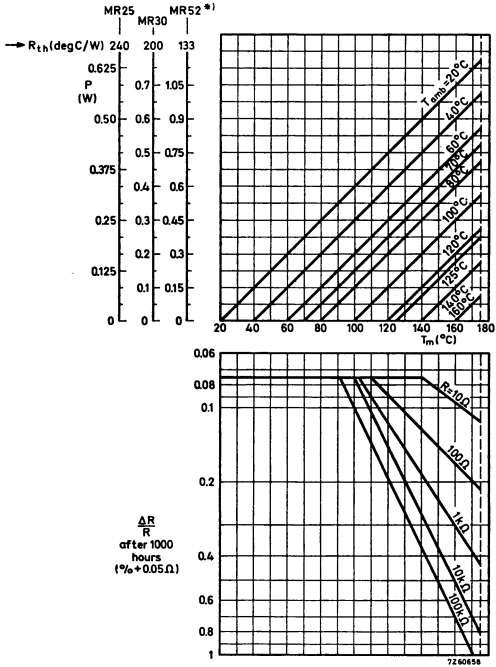
In the above mentioned catalog number replace the first two dots by the first two digits of the resistance value. Replace the third dot by a figure according to the following table:

1– 9.1 Ω	8	10– 91 kΩ	3
10– 91 Ω	9	100–910 kΩ	4
100–910 Ω	1	1– 9.1 MΩ	5
1– 9.1 kΩ	2	10– 22 MΩ	6

Lacquered metal film resistors
temperature coefficient 100 ppm/deg C

style	D_{max}	L_{max}	d
MR25	2.5	6.5	0.6
MR30	3.0	10.0	0.6
MR52	5.2	16.0	0.6





Performance nomogram for different styles of resistor, showing the relationship between power dissipation P, ambient temperature T_{amb} hot-spot temperature (T_m) and max. resistance drift $\Delta R/R$ after 1000 hours of operation.

FIXED RESISTORS

Standard range

style	*resistance range*	*tolerance (± %)*	*series*	*limiting voltage (V)*	*cat. number 2322 followed by*
MR25	4.99 Ω–301 kΩ	1	E 96	250	151 5....
MR25	5.1 Ω–300 kΩ	2	E 24	250	151 4....
MR30	4.99 Ω–1 MΩ	1	E 96	350	152 5....
MR30	5.1 Ω–1 MΩ	2	E 24	350	152 4....
MR52	4.99 Ω–1 MΩ	1	E 96	500	153 5....
MR52	5.1 Ω–1 MΩ	2	E 24	500	153 4....

Composition of the catalogue number

2322 ... .

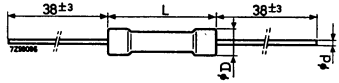
Style code see table

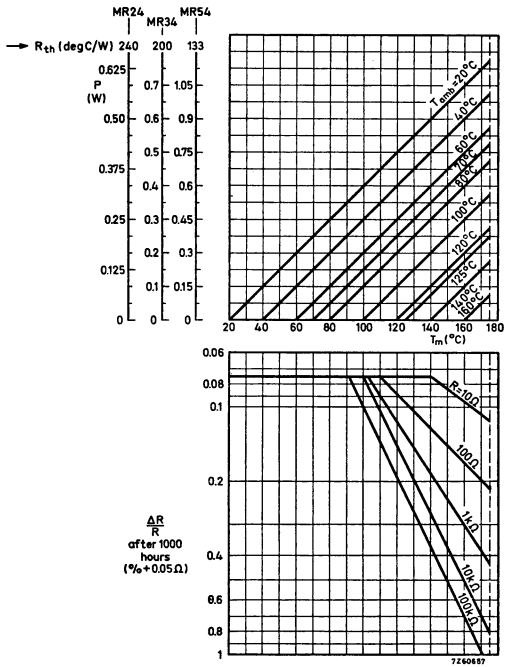
Tolerance code
4 for ±2%
5 for ±1%

Resistance value code first three significant figures of the resistance value (in Ω) followed by
8 for R of 4.99 to 9.76 Ω
9 for R of 10 to 97.6 Ω
1 for R of 100 to 976 Ω
2 for R of 1 to 9.76 kΩ
3 for R of 10 to 97.6 kΩ
4 for R of 100 to 976 kΩ
5 for R of 1 MΩ

Lacquered metal film resistors
temperature coefficient 50 ppm/deg C

Style	D_{max}	L_{max}	*d*
MR24	2.5	6.5	0.6
MR34	3.1	10.5	0.6
MR54	5.2	16.5	0.6





Performance nomogram for different styles of resistor, showing the relationship between power dissipation P, ambient temperature T_{amb}, hot-spot temperature (T_m) and max. resistance drift $\Delta R/R$ after 1000 hours of operation.

FIXED RESISTORS

Standard range

style	*resistance range*	*tolerance (± %)*	*series*	*limiting voltage (V)*	*cat. number 2322 followed by*
MR24	49.9 Ω–301 kΩ	1	E96	250	161 5....
MR34	49.9 Ω–681 kΩ	1	E96	350	164 5....
MR54	49.9 Ω– 1 MΩ	1	E96	500	167 5....

Composition of the catalogue number

2322...5....

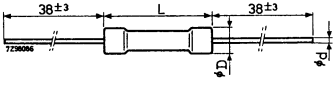
Style code see table

Tolerance code

Resistance value code, first three significant figures of the resistance value (in Ω) followed by
9 for R of 49.9 to 97.6 Ω
1 for R of 100 to 976 Ω
2 for R of 1 to 9.76 kΩ
3 for R of 10 to 97.6 kΩ
4 for R of 100 to 976 kΩ
5 for R of 1 MΩ

Lacquered metal film resistors according to MIL-R-10509F

style	D_{max}	L_{max}	*d*
MR24 E/C/D	2.5	6.5	0.6
MR34 E/C/D	3.1	10.5	0.6
MR54 E/C/D	5.2	16.5	0.6
MR74 E/C/D	6.8	20.5	0.8



style	*rated dissipation (W)*	*maximum temperature coefficient (ppm/deg C)*	*resistance range and tolerance*	*max. voltage (V)*	*MIL style*	*style code see composition*
	at 125°C		0.1/0.25/0.5/1% E192 series			
MR24E	0.1	25	49.9 Ω–100 kΩ	200	RN55E	160
MR24C	0.1	50	49.9 Ω–100 kΩ	200	RN55C	161
MR34E	0.125	25	49.9 Ω–499 kΩ	250	RN60E	163
MR34C	0.125	50	49.9 Ω–499 kΩ	250	RN60C	164
MR54E	0.25	25	49.9 Ω– 1 MΩ	300	RN65E	166
MR54C	0.25	50	49.9 Ω– 1 MΩ	300	RN65C	167
MR74E	0.5	25	24.9 Ω– 1 MΩ	350	RN70E	169
MR74C	0.5	50	24.9 Ω– 1 MΩ	350	RN70C	170
	at 70°C		1%, E96 series			
MR24D	0.125	100	10 Ω–301 kΩ	200	RN55D	162
MR34D	0.25	100	10 Ω– 1 MΩ	300	RN60D	165
MR54D	0.5	100	10 Ω– 1 MΩ	350	RN65D	168
MR74D	0.75	100	10 Ω– 1 MΩ	500	RN70D	171

Composition of the calatogue number

2322 . . . . . .

Style code see table above

Tolerance code
1 for ±1%
2 for ±0.5%
3 for ±0.25%
4 for ±0.1%

Resisance value code: first three significant figures of the resistance value (in Ω) followed by
9 for R of 10 to 98.8 Ω
1 for R of 100 to 988 Ω
2 for R of 1 to 9.88 kΩ
3 for R of 10 to 98.8 kΩ
4 for R of 100 to 988 kΩ
5 for R of 1 MΩ

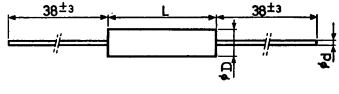
FIXED RESISTORS

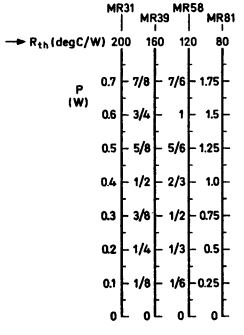
For the resistance values mentioned in the following table the "Composition of the catalogue number" is not applicable. In this table the last 5 digits of the catalogue number are stated in full.

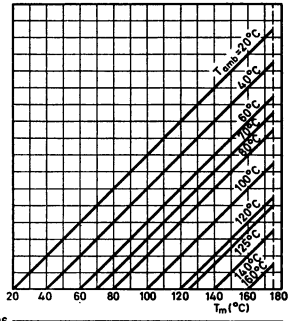
resistance value	*last 5 digits of the catalogue number*			
(Ω)	0.1%	0.25%	0.5%	1%
29.9	90102	90122		
39.9	90103	90123		
49.9	90104	90124	90134	90144
59.9	90105	90125		
69.9	90106	90126		
79.9	90107	90127		
89.9	90108	90128		
99.9	90109	90129		

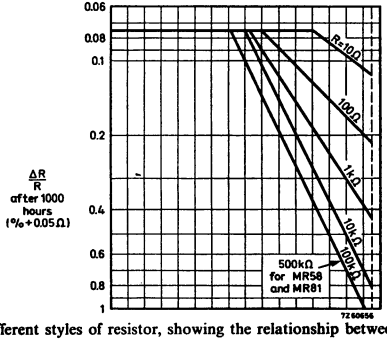
Moulded metal film resistors
according to MIL-R-10509F

style	$D \pm 0.2$	$L \pm 0.2$	d
MR31	3.1	6.9	0.6
MR39	3.9	10.9	0.6
MR58	6.3	17.6	0.6
MR81	8.1	20.5	0.8









Performance nomogram for different styles of resistor, showing the relationship between power dissipation P, ambient temperature T_{amb}, hot-spot temperature (T_m) and max. resistance drift $\Delta R/R$ after 1000 hours of operation.

FIXED RESISTORS

Standard range

style	*maximum temp. coeff. (ppm/degC)*	*resistance range*	*tolerance (± %)*	*series*	*limiting voltage (V)*	*cat. number 2322 followed by*
MR31E	25	49.9 Ω–100 kΩ	0.1/0.25/0.5/1	E192[1])	250	123 .....
MR31C	50	49.9 Ω–100 kΩ	0.1/0.25/0.5	E192	250	124 .....
MR39E	25	49.9 Ω–499 kΩ	0.1/0.25/0.5/1	E192[1])	350	126 .....
MR39C	50	49.9 Ω–499 kΩ	0.1/0.25/0.5	E192	350	127 .....
MR58E	25	49.9 Ω– 1 MΩ	0.1/0.25/0.5/1	E192[1])	500	129 .....
MR58C	50	49.9 Ω– 1 MΩ	0.1/0.25/0.5	E192	500	130 .....
MR81E	25	24.9 Ω– 1 MΩ	0.1/0.25/0.5/1	E192[1])	750	132 .....
MR81C	50	24.9 Ω– 1 MΩ	0.1/0.25/0.5/1	E192[1])	750	133 .....
MR81D	100	4.99 Ω– 1 MΩ	1	E 96	750	134 5 ...

Composition of the catalogue number

2322 ... .

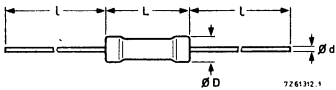
Style code see table

Tolerance code
5 for ±1 %
6 for ±0.5 %
7 for ±0.25 %
8 for ±0.1 %

Resistance value code first three significant figures of the resistance value (in Ω) followed by
8 for R of 4.99 to 9.88 Ω
9 for R of 10 to 98.8 Ω
1 for R of 100 to 988 Ω
2 for R of 1 to 9.88 kΩ
3 for R of 10 to 98.8 kΩ
4 for R of 100 to 988 kΩ
5 for R of 1 MΩ

[1]) For 1% tolerance E96 values only.

Power metal film resistors PR37/PR52



style	L_{max}	l_{max}	D_{max}	d_{max}
PR37	10	41	3,7	0,7
PR52	16,7	41	5,2	0,8

Resistance range	PR37: 10 Ω to 10 kΩ, E24 series
	PR52: 10 Ω to 27 kΩ, E24 series
Resistance tolerance	±5%
Temperature coefficient	max. 500 ppm/deg C
Maximum body temperature (hot spot)	300°C
Rated dissipation at $T_{amb} = 70°C$	PR37: 1,6 W
	PR52: 2,5 W
Basic specification	PR37: MIL-R-11804/2B, char. G
	PR52: MIL-R-11804/2B, char. G, Style RD60
Climatic category (IEC 68)	55/200/56

Composition of the catalogue number

2322 19. 3.. 0.

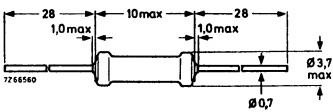
Style code
191 PR37
192 PR52

Tolerance code
3 for 5%

9 for R of 10 to 91 Ω
1 for R of 100 to 910 Ω
2 for R of 1000 to 9100 Ω
3 for R of 10000 to 27000 Ω

First two digits of the resistance value (E24 series)

High voltage resistor VR37



FIXED RESISTORS

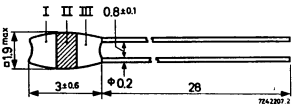
Resistance range	1 MΩ to 33 MΩ, E24 series
Resistance tolerance	±5%
Temperature coefficient	±200 ppm/deg C
Max. body temperature (hot spot)	155°C
Rated dissipation at $T_{amb} = 70°C$	0,5 W
Limiting voltage	2500 V r.m.s.
Dielectric withstanding voltage of the insulation for 1 minute	min 700 V r.m.s.
Basic specification	IEC115, type 1B
Climatic category (IEC68)	55/155/56
Noise	≦2,5 μV/V

Composition of the catalogue number

2322 242 13 . . .

- first two digits of the resistance value
- 5 for R of 1 MΩ to 9,9 MΩ
- 6 for R of 10 MΩ to 33 MΩ

Insulated pin-head carbon resistors



Max. dissipation at 70°C	0.05 W
Resistance values	47 Ω to 120 kΩ, E12 series
Tolerance	±10% and ±20%
Noise	<10 μV/V
Limiting voltage, peak value	50 V_p
Temperature coefficient (from +25 to +70°C)	(+1000 to −2000) 10^{-6}/deg C
Ambient temperature range	−10 to +100°C
International colour code	

Composition of the catalog number

For tolerance +10%: 2322 120 22 . . .

For tolerance +20%: 2322 120 21 . . .

The first two digits of the resistance value, neglecting a decimal point.

digit for multiplying factor:

9 = × 1

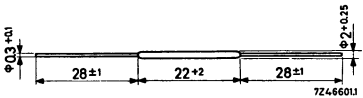
1 = × 10

2 = × 100

3 = × 1000

4 = × 10000

Low-ohmic glass-sealed wire resistors



Maximum dissipation at 40°C	1 W
Resistance values	0.1 to 6.8 Ω, E12 series
Tolerance	±10%
Temperature coefficient	(−50 to +150) 10^{-6}/deg C
Operating body temperature	−25 to +275°C

Composition of the catalog number

2322 327 61 . . .

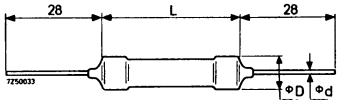
The first two digits of the resistance value, neglecting a decimal point.

digit for multiplying factor:

7 = × 0.01

8 = × 0.1

Precision wire-wound resistors



FIXED RESISTORS

Max. dissipation at 40°C	0.4 to 1.8 W
Resistance values	1 Ω to 57 kΩ, E192 series
Tolerance	±0.5% and ±0.25%
Temperature coefficient (±)	$<20.10^{-6}$/deg C
Ambient temperature range	−55 to +110°C

P_{nom} (W)	*nominal resistances* min. (Ω)	max. (kΩ)	$D_{max.}$	$L_{max.}$	*d*	*catalog series number*
0.4	1	3.2[1])	4	13	0.8	260
0.6	3	7	5	19	0.8	261
0.7	6	12.5	5	28	0.8	262
1.2	17	33	7	43	1	263
1.8	25	57	7	67	1	264

Composition of the catalog number

2322 . . . . . .

Series number, see above

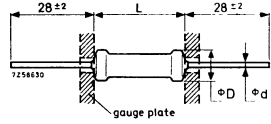
Tolerance code: 5 = ±0.5 %
6 = ±0.25%

Multiplier code: 8 = × 0.01 Ω
9 = × 0.1 Ω
1 = × 1 Ω
2 = × 10 Ω
3 = × 100 Ω

The first three digits of the resistance value, neglecting a decimal point

Cemented wire-wound resistors

style	$D_{max.}$	$L_{max.}$	*d*
WR0617	6	19	0.6
WR0825	8	27	0.8
WR0842	8	44	0.8
WR0865	8	67	0.8



[1]) 487 Ω for tolerance of 0.25%

Max. permissible surface temperature	400 °C
Ambient temperature range	−40 to +155 °C
Temperature coefficient	−50 to +160·10⁻⁶/degC

style	*dissipation at 40 °C*	*resistance range (E12 series)*	*tolerance*	*catalog number*
WR0617	4 W	5.6–47 Ω	±10%	2322 325 36...
		56–4700 Ω	±5%	2322 325 37...
WR0825	7 W	6.8–27 Ω	±10%	2322 325 26...
		33–10000 Ω	±5%	2322 325 27...
WR0842	9.5 W	10–10000 Ω	±5%	2322 325 17...
WR0865	15 W	15–16000 Ω	±5%	2322 325 07...

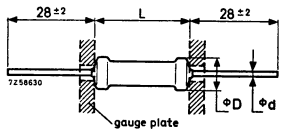
Catalog number suffix

In the above mentioned catalog number replace the first two dots by the first two digits of the resistance value. Replace the third dot by a figure according to the following table:

5.6	–	9.1 Ω	: 8
10	–	91 Ω	: 9
100	–	910 Ω	: 1
1000	–	9100 Ω	: 2
10000	–	16000 Ω	: 3

Enamelled wire-wound resistors

style	D_{max}	L_{max}	*d*
WR0617E	6	19	0.6
WR0825E	8	27	0.8
WR0842E	8	44	0.8
WR0865E	8	67	0.8



Maximum body temperature		400 °C
Ambient temperature range		−55 to +200 °C
Temperature coefficient	WR0617E 4.7 to 16 Ω	(−50 to +250) ppm/degC
	>16 Ω	(−50 to +140) ppm/degC
	WR0825E 6.8 to 33 Ω	(−50 to +250) ppm/degC
	>33 Ω	(−50 to +140) ppm/degC
	WR0842E and WR0865E	(−50 to +140) ppm/degC

style	*rated dissipation at* $T_{amb} = 70°C$	*resistance range*	*tolerance*	*series*	*catalogue number*
WR0617E	4.2 W	4.7– 47 Ω	±10%	E12	2322 330 21 . . .
		51– 4700 Ω	± 5%	E24	2322 330 22 . . .
WR0825E	7 W	6.8– 27 Ω	±10%	E12	2322 330 31 . . .
		30– 27000 Ω	± 5%	E24	2322 330 32 . . .
WR0842E	11 W	10– 56000 Ω	± 5%	E24	2322 330 42 . . .
WR0865E	17 W	15–100000 Ω	± 5%	E24	2322 330 52 . . .

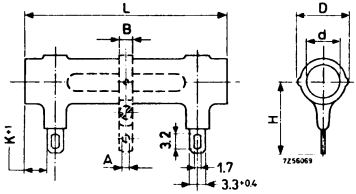
Composition of the catalogue number

In the above mentioned catalogue number replace the first two dots by the first two digits of the resistance value. Replace the third dot by a figure according to the following table:

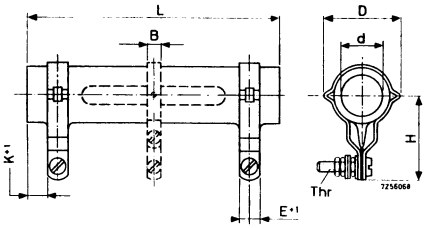
4.7– 9.1 Ω	: 8
10 – 91 Ω	: 9
100 – 910 Ω	: 1
1000 – 9100 Ω	: 2
10000 – 91000 Ω	: 3
100000 Ω	: 4

Fixed and adjustable wire-wound resistors with side terminations

	cemented	*enamelled*
Max. dissipation at 40°C (P_{nom})	8(10)–250 W	8(10)–100 W
Resistance values (E12 series)	1 Ω–11 kΩ	160 Ω–120 kΩ (47 kΩ)
Tolerance	±5% (±10%)	±5%
Temperature coefficient	(−50 to +140) 10^{-6}/deg C	
Ambient temperature range	−55 to +155°C	



Resistors with $P_{nom} \leqslant 40$ W



Resistors with $P_{nom} \geqslant 60$ W

P_{nom} (W)	*dimensions in mm*								
	$D_{max.}$	$d_{min.}$	H	K	E	$L_{max.}$	B	A	*Thr*
8	11.5	5	14	2.5	—	26	—	—	—
10	11.5	5	14	4	—	41	5	2.8	—
16	11.5	5	14	4	—	63	5	2.8	—
25	16	8	14	4	—	64	6	3.2	—
40	16	8	14	4	—	103	6	3.2	—
60	32	12.5	33	6	9	103	6	—	M4
100	32	12.5	33	6	9	165	6	—	M4
160	44	20	40	8	11	165	8	—	M4
250	44	20	40	8	11	256	8	—	M4

Composition of the catalog number

2322 . . . . . .

See table

The first two digits of the resistance value, neglecting a decimal point.

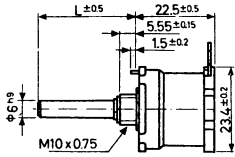
Multiplier code: 8 = × 0.1 Ω
9 = × 1 Ω
1 = × 10 Ω
2 = × 10^2 Ω
3 = × 10^3 Ω
4 = × 10^4 Ω

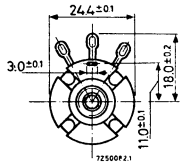
coating	P_{nom} [1]	resistance values R_{nom} [1]				short circuit [1]	$D_{max.}$	$L_{max.}$	catalog number 2322 followed by	
		tol.	min.	maxim. (Ω)					fixed	adjust.
	(W)	(± .. %)	(Ω)	fixed	adjust.	(% R_{nom})	mm	mm		
cement	8	10	1	100			11.5	26	323 14 ...	
		5	110	150					323 34 ...	
enamel		5	160	6800					321 34 ...	
cement	10	10	1.2	27	27	9	11.5	41	323 12 ...	324 12 ...
		5	30	300	300				323 32 ...	324 32 ...
enamel		5	330	12000	3300				321 32 ...	322 32 ...
cement	16	10	1.5	2.7	2.7	5	11.5	63	323 10 ...	324 10 ...
		5	3	620	620				323 30 ...	324 30 ...
enamel		5	680	24000	6800				321 30 ...	322 30 ...
cement	25	10	2.7	15	15	4	16	64	323 08 ...	324 08 ...
		5	16	820	820				323 28 ...	324 28 ...
enamel		5	1000	39000	9100				321 28 ...	322 28 ..
cement	40	5	4.7	1600	1600	2.5	16	103	323 26 ...	324 26 ...
enamel		5	1800	75000	18000				321 26 ...	322 26 ...
cement	60	5	3	2200	2200	3	32	103	323 24 ...	324 24 ...
enamel		5	2400	68000	24000				321 24 ...	322 24 ...
cement	100	5	6.8	4300	4300	1.5	32	165	323 23 ...	324 23 ...
enamel		5	4700	120000	47000				321 23 ...	322 23 ...
cement	160	5	10	6800	6800	1.5	44	165	323 22 ...	324 22 ...
cement	250	5	16	11000	11000	1	44	256	323 21 ...	324 21 ...

[1]) The adjustable contact short-circuits a number of windings. The maximum resistance loss has been given as a percentage of the nominal resistance. Nominal dissipation and nominal resistance values apply if no contact strap were connected.

VARIABLE RESISTORS

Wire-wound trimming potentiometers





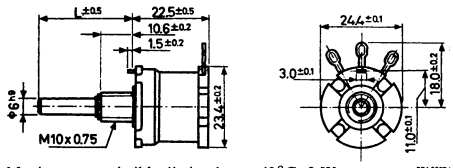
Maximum permissible dissipation at 40 °C 3 W
at 70 °C 2 W

adjustment	*spindle length*	*catalog number*
screw driver	9 mm	2322 000 02 . . .
knob	15 mm	2322 000 22 . . .
knob	20 mm	2322 000 32 . . .

resistance values (Ω) ±5%	*catalog number suffix*
47	479
50	509
68	689
75	759
100	101
150	151
200	201
220	221
250	251
330	331

resistance values (Ω) ±5%	*catalog number suffix*
470	471
500	501
680	681
750	751
1000	102
1500	152
2000	202
2200	222
2500	252
3300	332

Wire-wound potentiometers



Maximum permissible dissipation at 40°C: 3 W
at 70°C: 2 W

adjustment	*spindle length L*	*catalog number*
screw driver	14 mm	2322 003 0 ....[1])
		010 0 ....[2])
knob	17 mm	2322 003 2 ....
		010 2 ....
knob	20 mm	2322 003 3 ....
		010 3 ....
knob	30 mm	2322 003 4 ....
		010 4 ....
knob	60 mm	2322 003 5 ....
		010 5 ....

[1]) 2322 003 for radial soldering tags
[2]) 2322 010 for tags in axial direction

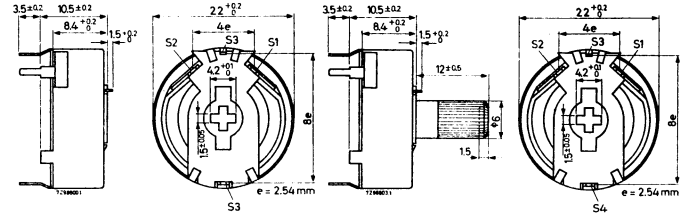
1 = $R \pm 10\%$
2 = $R \pm 5\%$
6 = $R \pm 10\%$ with center tap
7 = $R \pm 5\%$ with center tap

resistance value in Ω	*temperature coefficient in 10^{-6}/deg C*	*catalog number suffix*
2.2	0 to +600	228
3.3	0 to +600	338
4.7	0 to +600	478
6.8	0 to +600	688
10	0 to +600	109
15	0 to +600	159
22	0 to +600	229
33	−25 to +600	339
47	−25 to +600	479
68	−25 to +25	689
100	−25 to +25	101
150	−25 to +25	151
220	−25 to +25	221

resistance value in Ω	*temperature coefficient in 10^{-6}/deg C*	*catalog number suffix*
330	−25 to +140	331
470	−25 to +140	471
680	0 to +140	681
1000	0 to +140	102
1500	0 to +140	152
2200	0 to +140	222
3300	0 to +140	332
4700	0 to +140	472
6800	0 to +140	682
10000	−20 to +140	103
15000	−20 to +140	153
22000	−20 to +140	223

VARIABLE RESISTORS

Wire-wound trimming potentiometers



Non-tapped potentiometer without knob

Tapped potentiometer with knob

For mounting on printed-wiring boards
Maximum permissible dissipation at 40 °C: 2 W
at 70 °C: 1 W

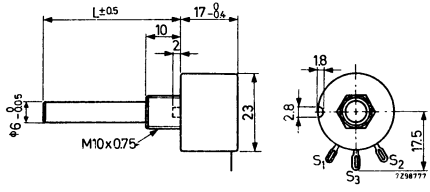
Catalog number: 2322 011 . . . .

02 = without tap, without knob
03 = with tap, without knob
22 = without tap, with knob
23 = with tap, with knob

resistance code, see table

resistance value ±10 % (Ω)	*resistance code*	*resistance value* ±10 % (Ω)	*resistance code*
2.2	228	120	121
3.3	338	150	151
4.7	478	180	181
6.8	688	220	221
10	109	330	331
15	159	470	471
22	229	680	681
33	339	1000	102
47	479	11 + 11	229
68	689	50 + 50	101
100	101	150 + 150	301

Wire-wound potentiometers



Maximum permissible dissipation at 70°C: 1 W

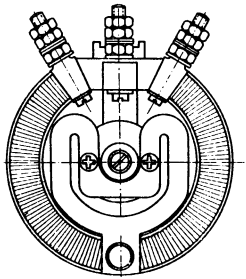
adjustment	*spindle length L*	*catalog number*	
screwdriver	14	2322 01[0....	2 = plastic spindle
knob	17	2....	3 = steel spindle
knob	25	3....	
knob	50	4....	
knob	60	5....	1 = $R \pm 10\%$
knob	20	6....	2 = $R \pm 5\%$ ($R > 47\ \Omega$)
knob	30	7....	

resistance value in Ω	*temperature coefficient in 10^{-6}/deg C*	*catalog number suffix*
2.2	0 to +600	228
3.3	0 to +600	338
4.7	0 to +600	478
6.8	0 to +600	688
10	0 to +600	109
15	0 to +600	159
22	−25 to +25	229
33	−25 to +25	339
47	−25 to +25	479
68	−25 to +25	689
100	−25 to +25	101
150	−25 to +25	151

resistance value in Ω	*temperature coefficient in 10^{-6}/deg C*	*catalog number suffix*
220	0 to +140	221
330	0 to +140	331
470	0 to +140	471
680	0 to +140	681
1000	0 to +140	102
1500	0 to +140	152
2200	0 to +140	222
3300	0 to +140	332
4700	0 to +140	472
6800	0 to +140	682
10000	−20 to +140	103
15000	−20 to +140	153
22000	−20 to +140	223

VARIABLE RESISTORS

Load potentiometers



max. perm. dissipation	*dimensions in mm diameter*	*length*)*	*catalog number*
25 W	36	26	2322 095 .....
40 W	46	32	2322 096 .....
100 W	66	48	2322 097 .....

*) behind mounting panel

Temperature coefficient	$(-140 \text{ to } +140)10^{-6}$/deg C
Ambient temperature range	-55 to $+100$°C

Composition of the catalog number

2322 ... ...

- code for nominal dissipation
- code for resistance value, see Table
- 21 for spindle length = 17 mm
- 31 for spindle length = 36 mm

resistance values ±10%	*resistance code*	*resistance values* ±10%	*resistance code*
0.5 Ω [1]	507	100 Ω	101
0.75 [2]	757	150	151
1	108	200	201
1.5	158	250	251
2	208	350	351
2.5	258	500	501
3.5	358	750	751
5	508	1000	102
7.5	758	1500	152
10	109	2000	202
15	159	2500	252
20	209	3500	352
25	259	5000	502
35	359	7500	752
50	509	10000 [2]	103
75	759		

[1]) Not available in 25 W and 100 W. [2]) Not available in 25 W.

Ganging units

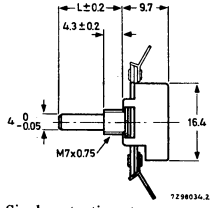
For ganging two load potentiometers ganging units are available.

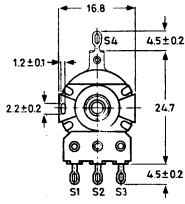
16 mm carbon potentiometers (CP16-series)

The CP-16 series includes two types of potentiometers.

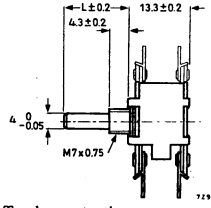
The single potentiometers can be delivered without switch or with a rotary switch, the tandem potentiometers only without switch.
Both types are available with different connecting terminals, mounting facilities and spindles.

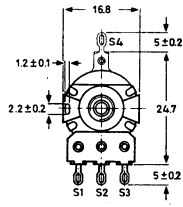
Max. permissible dissipation at 40°C
resistance law a[1]): 0.1 W
resistance laws b to f[1]): 0.05 W





Single potentiometer





Tandem potentiometer

Composition of the catalog number (see also Tables)

2322 . . . . . .

code for type and switch — code for resistance value and law
code for terminals, mounting facility and material of spindle — code for spindle type

potentiometer	*5th, 6th and 7th digit in catalog number*	
	single	*tandem*
without switch	380	390
with s.p.s.t. rotary switch (spring actuated)[2])	381	
with s.p.s.t. rotary switch (direct operating)	387	
without switch, with p.w. pins bent backwards[3])	389	

[1]) See note 5) pag. 140.
[2]) Only available with mounting bushing.
[3]) Only available with mounting bushing and p.w. pins of 9.3 mm length.

terminals	*mounting facility*	*8th digit in catalog number*	
		steel spindle	*plastic spindle*
p.w. pins, length 3.5 mm or solder tags	mounting bushing	0	7
	twist tags for mounting	2	4
p.w. pins, length 9.3 mm	mounting bushing	1	6
	twist tags for mounting	3	5

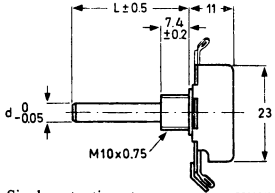
spindle length L, see Figs.	*9th and 10th digit in catalog number*[4])			
	plain	*with flat face*	*knurled*	*with screwdriver slot*
				10
10 mm	11	42	26	
12 mm	09			
15 mm	12	44	27	
17 mm	13			
19 mm	14			
20 mm	15	45	28	
22 mm	17			
24 mm	19			
25 mm	01			
28 mm	02			
30 mm	03			

[4]) For potentiometers with p.w. pins the 9th digit given in this table has to be increased by 5.

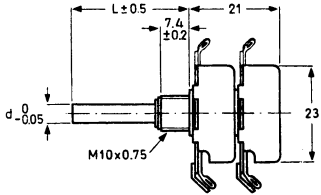
resistance value ±20%	*11th and 12th digit in catalogue number*			
	law a[5])	*law b*[5])	*law c*[5])	*law f*[5])
220 Ω	02			
470 Ω	03			
1 kΩ	04	24	44	
2.2 kΩ	05	25	45	
4.7 kΩ	06	26	46	
10 kΩ	07	27	47	91
22 kΩ	08	28	48	92
47 kΩ	09	29	49	93
100 kΩ	11	31	51	94
220 kΩ	12	32	52	95
470 kΩ	13	33	53	96
1 MΩ	14	34	54	97
2.2 MΩ	15	35	55	
4.7 MΩ	16			

resistance value ±20%	*11th and 12th digit in catalog number*	
	law d[5])	*law e*[5])
5+42 kΩ	72	
20+200 kΩ	67	
50+420 kΩ	73	
100+900 kΩ	64	
2+ 8 kΩ		76
5+ 17 kΩ		82
10+ 37 kΩ		86
20+ 80 kΩ		77
50+170 kΩ		83
100+370 kΩ		87
0.5 + 1.7 MΩ		84

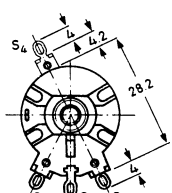
[5]) a = linear resistance law
b = logarithmic resistance law
c = reversed logarithmic resistance law
d = resistance law, tap at 10%
e = resistance law, tap at 20%
f = resistance law, balance potentiometers

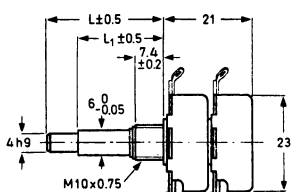


Single potentiometer 7Z98019.1

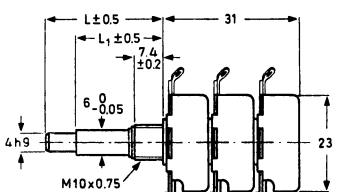


Tandem potentiometer 7Z98032.1

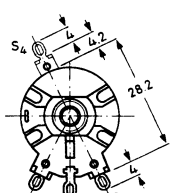




Twin potentiometer 7Z5021.1



Triple potentiometer 7Z61008

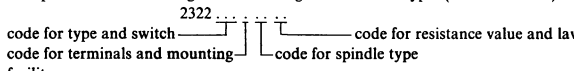


All four types, except the triple potentiometers which are all without switch can be delivered without switch, with a rotary switch or with a push-pull switch, besides all single and tandem potentiometers are available with different connecting terminals, mounting facilities and spindles. The twin and triple potentiometers are supplied with solder tags and mounting bushing.

VARIABLE RESISTORS

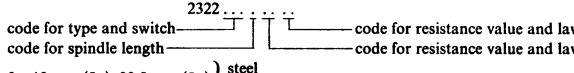
Max permissible dissipation at 40° C
resistance law a[1]): 0,25 W
resistance laws b to h[1]): 0,15 W

Composition of the catalog number of single and tandem types (see also Tables)


2322 . . . . . .
code for type and switch
code for terminals and mounting facility
code for resistance value and law
code for spindle type

3 = p.w. pins } mounting
7 = solder tags } bushing
5 = p.w. pins } twist tags
4 = solder tags } for mounting

Composition of the catalog number of twin and triple types (see also Tables)


2322 . . . . . .
code for type and switch
code for spindle length
code for resistance value and law of R_2
code for resistance value and law of R_1

0 = 18 mm (L_1), 30.5 mm (L_2) } steel hollow spindle
1 = 30 mm (L_1), 42.5 mm (L_2) }

6 = 18 mm (L_1), 30.5 mm (L_2) } plastic hollow spindle
7 = 30 mm (L_1), 42.5 mm (L_2) }

[1]) See note 4)

potentiometer	*5th, 6th and 7th digit in catalog number*			
	single	*tandem*	*twin*[2])	*triple*[2])
without switch	350	360	370	378
with s.p.d.t. rotary switch	352	363	372	
with s.p.s.t. rotary switch	353	362	373	
with d.p.s.t. push-pull switch, 1A	354	364	374	
with d.p.s.t. push-pull switch, 2A	355	365	375	
with d.p.d.t. push-pull switch	356			
with d.p.s.t. rotary switch	357	366	376	

[2]) For potentiometers with steel hollow spindle; for potentiometers with plastic hollow spindle the 5th digit is 4 in stead of 3.

spindle length L, see Figs. (only for single and tandem types)	*9th and 10th digit in catalog number*[1])				
	plain Ø6 mm	*plain* Ø6.35 mm	*with flat face*	*knurled*	*with screw-driver slot*
					10
17 mm	13	33			
18 mm	06	26	40	11	
19 mm	14	34			
20 mm	15	35			
22 mm	17	37			
25 mm	01	21	41		
28 mm			42		
30 mm	03	23	43	12	
35 mm	04	24	44		
40 mm	05	25	45		
60 mm	07	27	47	31	
70 mm	08	28	48		
90 mm[2])	09	29	49		

[1]) For potentiometers with printed-wiring pins the 9th digit given in this table has to be increased by 5. [2]) Only for single types.

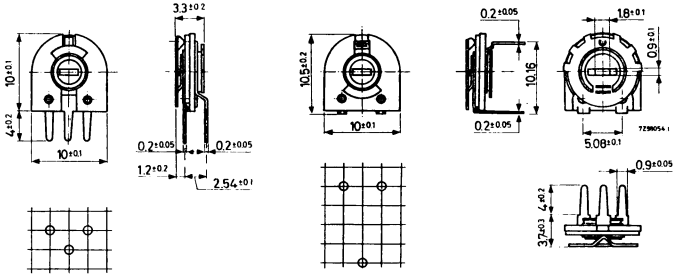
resistance value ±20%	*11th and 12th digit in catalog number*			
	law a[4])	*law b*[4])	*law c*[4])	*law h*[4])
220 Ω	02			
300 Ω	19		59	
470 Ω	03		43	
1 kΩ	04	24	44	
2.2 kΩ	05	25	45	
4.7 kΩ	06	26	46	
10 kΩ	07	27	47	
22 kΩ	08	28	48	92
47 kΩ	09	29	49	93
100 kΩ	11	31	51	94
220 kΩ	12	32	52	95
470 kΩ	13	33	53	96
1 MΩ	14	34	54	97
2.2 MΩ	15	35	55	
4.7 MΩ	16	36		

resistance value ±20%	*11th and 12th digit in catalog number*				
	law d[4])	*law e*[4])	*law f*[4])	*law g*[4])	
20 + 200 kΩ	67				
50 + 420 kΩ	73				
100 + 900 kΩ	64				
0.2 + 2 MΩ	68				
0.5 + 1.7 kΩ		81			
5 + 17 kΩ		82			
10 + 37 kΩ		86			
20 + 80 kΩ		77			
50 + 170 kΩ		83			
100 + 370 kΩ		87			
200 + 800 kΩ		78			
0.5 + 1.7 MΩ		84			
400 + 600 kΩ			89		
200 + 100 kΩ				65	

[4]) a = linear resistance law
b = logarithmic resistance law
c = reversed logarithmic resistance law
d = resistance law, tap at 10%
e = resistance law, tap at 20%
f = linear resistance law, tap at 40%
g = linear resistance law, tap at 67%
h = resistance law, balance potentiometers

VARIABLE RESISTORS

Miniature carbon trimming potentiometers



Max. permissible dissipation at 40°C: 0.1 W

types	*catalog number*
for vertical mounting, without knob	2322 410 050 . .
for vertical mounting, with knob	2322 410 450 . .
for horizontal mounting, without knob	2322 410 033 . .
for horizontal mounting, with knob	2322 410 433 . .

resistance value ±20%	*catalog number suffix*
100 Ω	01
220 Ω	02
330 Ω	19
470 Ω	03
1 kΩ	04
2.2 kΩ	05
4.7 kΩ	06

resistance value ±20%	*catalog number suffix*
10 kΩ	07
22 kΩ	08
47 kΩ	09
100 kΩ	11
220 kΩ	12
470 kΩ	13
1 MΩ	14
2.2 MΩ	15
4.7 MΩ	16

Carbon trimming potentiometers

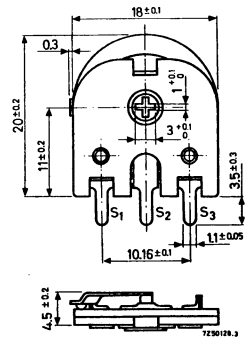
Max. permissible dissipation at 40°C: 0.25 W

Composition of the catalog number

2322 411 . . . . .

0 = without knob
1 = with knob at the side of the base plate
2 = with knob at the side of the carbon track
4 = with adjustment wheel

00 = with soldering tags
22 = with pins for vertical mounting
33 = with pins for horizontal mounting
72 = with pins for vertical mounting (according to DIN 44 150)
83 = with pins for horizontal mounting (according to DIN 44 150)
84 = with pins for horizontal mounting (according to DIN 44 151)

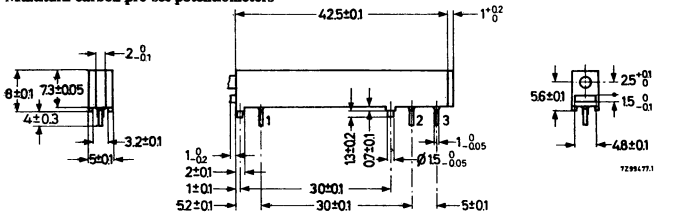


code for resistance value, see table

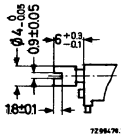
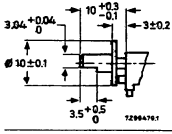
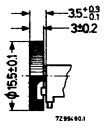
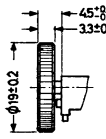
resistance value ±20%	*code in catalog number*	*resistance value* ±20%	*code in catalog number*
100 Ω	01	47 kΩ	09
220 Ω	02	100 kΩ	11
330 Ω	19	220 kΩ	12
470 Ω	03	470 kΩ	13
1 kΩ	04	1 MΩ	14
2.2 kΩ	05	2.2 MΩ	15
4.7 kΩ	06	4.7 MΩ	16
10 kΩ	07	10 MΩ	17
22 kΩ	08		

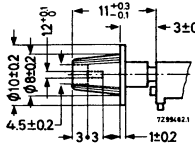
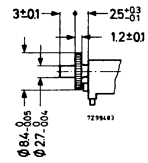
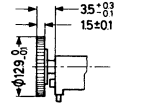
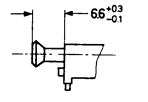
VARIABLE RESISTORS

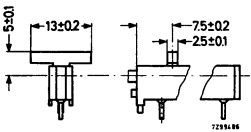
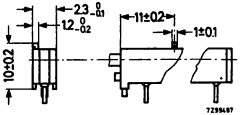
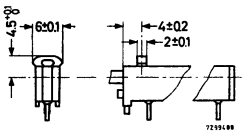
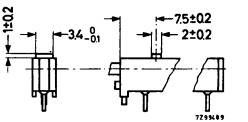
Multiturn carbon pre-set potentiometers



Housing without adjustment provision and scale indicator. Terminals 1 and 2 are connected to the ends of the carbon track, terminal 3 is connected to the slider contact.

adjustment provision	*code in catalog number*
	51
	52
	61
	62

adjustment provision	*code in catalog number*
	63
	81
	82
	83

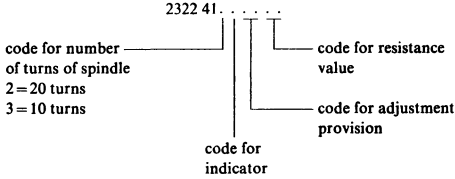
indicator	*with/without dust cover*	*code in catalog number*
	without	1
	without	2
	without	3
	without	4
without indicator	without	0
without indicator	which	8

VARIABLE RESISTORS

Max. permissible dissipation at 40°C

linear resistance law	0.4 W
logarithmic resistance law	0.3 W

Composition of the catalog number


2322 41. . . . . .
code for number of turns of spindle
2 = 20 turns
3 = 10 turns
code for indicator
code for resistance value
code for adjustment provision

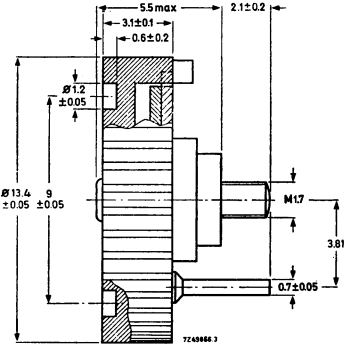
resistance value ±20%	*code in catalog number*	
	linear	*logarithmic*
100 Ω	01	
220 Ω	02	
470 Ω	03	
1 kΩ	04	24
2.2 kΩ	05	25
4.7 kΩ	06	26
10 kΩ	07	27
22 kΩ	08	28
47 kΩ	09	29
100 kΩ*	11	31
220 kΩ	12	32
470 kΩ	13	33
1 MΩ	14	34
2.2 MΩ	15	35
4.7 MΩ	16	

*) Also available with special law; code: 38

Miniature carbon potentiometers

Maximum voltage over the resistance element	10 $V_{d.c.}$
Current through slider	$\leqslant$ 1 mA
Working-temperature range	-10 to $+70$°C

resistance value ±20%	*catalog number suffix* 2322 440 000 . .	
	linear	*logarithmic*
4700 Ω	06	26
10000 Ω	07	27
22000 Ω	08	28

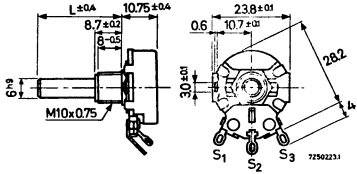


Single carbon potentiometers

Max. permissible dissipation at 40°C

linear resistance law 1 W

logarithmic resistance law 0.5 W

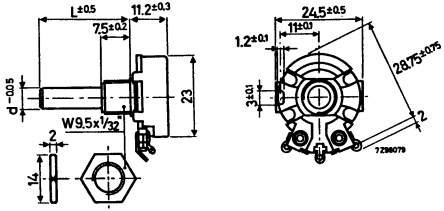


spindle type (plastic)	*catalog number*
plain, L = 17 mm	2322 450 013 . .
L = 30 mm	003 . .
L = 60 mm	007 . .
with screwdriver slot,	
Ø 6.35 mm, L = 12.7 mm	904 . .
L = 22.2 mm	907 . .
L = 31.8 mm	910 . .
L = 63.5 mm	920 . .

resistance values ±20%	*catalog number suffix*	
	linear	*logarithmic*
100 Ω	01	
220 Ω	02	
470 Ω	03	23
1 kΩ	04	24
2.2 kΩ	05	25
4.7 kΩ	06	26
10 kΩ	07	27
22 kΩ	08	28
47 kΩ	09	29
100 kΩ	11	31
220 kΩ	12	32
470 kΩ	13	33
1 MΩ	14	34
2.2 MΩ	15	35
4.7 MΩ	16	

VARIABLE RESISTORS

23 mm single carbon potentiometers



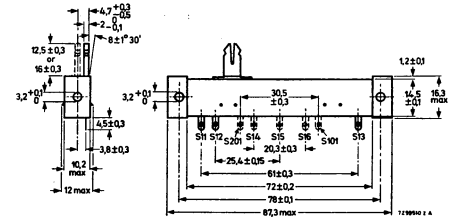
Max. permissible dissipation at 40 °C
linear resistance law 1 W
logarithmic resistance law 0.5 W

spindle type (plastic)	*catalog number*
plain, $d=6$ mm, $L=18$ mm	2322 460 706 . .
$L=30$ mm	703 . .
$L=60$ mm	707 . .
plain, $d=\frac{1}{4}''$, $L=30$ mm	723 . .
$L=60$ mm	727 . .
with screwdriver slot, $d=6$ mm, $L=11$ mm	710 . .
with flat face, $d=6$ mm, $L=18$ mm	740 . .
$L=30$ mm	743 . .
$L=60$ mm	747 . .

resistance value ±20%	*catalog number suffix* *linear*	*logarithmic*
220 Ω	02	
300 Ω	19	
470 Ω	03	
1 kΩ	04	24
2.2 kΩ	05	25
4.7 kΩ	06	26
10 kΩ	07	27
22 kΩ	08	28

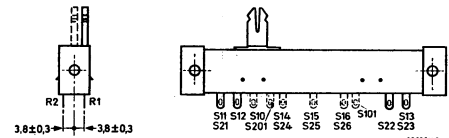
resistance value ±20%	*catalog number suffix* *linear*	*logarithmic*
47 kΩ	09	29
100 kΩ	11	31
220 kΩ	12	32
470 kΩ	13	33
1 MΩ	14	34
2.2 MΩ	15	35
4.7 MΩ	16	

Slide carbon potentiometers



Single slide potentiometer

S_{11}, S_{13} = beginning and end terminals respectively
S_{12} = slider terminal
S_{14}, S_{15}, S_{16} = tap terminals at 1/3, 1/2 and 2/3 of the total travel respectively
S_{101}, S_{201} = earthing terminals (connected to external screening)



Tandem slide potentiometer

S_{11}, S_{13}	= beginning and end terminals resp.	potentiometer 1 (R1)	S_{21}, S_{23}	= beginning and end terminals resp.	potentiometer 2 (R2)
S_{12}	= slider terminal		S_{22}	= slider terminal	
S_{14}, S_{15}, S_{16}	= tap terminals at 1/3, 1/2 and 2/3 of the total travel resp.		S_{26}, S_{25}, S_{24}	= tap terminals at 1/3, 1/2 and 2/3 of the total travel resp.	

S_{101}, S_{201} = earthing terminals (connected to external screening)
S_{10} = earthing terminal (connected to internal screening)

To make sure on which side potentiometer R1 is situated, the customer should look at the marking: this is always placed at the beginning of R1.

Max. permissible dissipation at 40°C
linear resistance law 0,4 W
logarithmic, reversed logarithmic
and semilogarithmic resistance law 0,2 W

VARIABLE RESISTORS

Composition of the catalogue number

2322 42. . . . .

code for screw-mounting facility

- 0 = without
- 1 = making use of holes in top and bottom
- 2 = making use of holes in the small sides
- 3 = making use of holes in front and back

(1, 2, 3: single)

- 5 = without
- 6 = making use of holes in top and bottom
- 7 = making use of holes in the small sides
- 8 = making use of holes in front and back

(5, 6, 7, 8: tandem)

code for resistance value and law, see table

code for taps

- 0 = without taps
- 1 = tap at 1/3
- 2 = tap at 1/2
- 4 = taps at 1/3 and 2/3

code for terminals and screening

- 0 = without screening
- 1 = with internal screening[1])
- 2 = with internal and external screening[1])
- 3 = with external screening

(0, 1, 2, 3: with solder tags)

- 5 = without screening
- 6 = with internal screening[1])
- 7 = with internal and external screening[1])
- 8 = with external screening

(5, 6, 7, 8: with printed-wiring pins)

code for adjustment provision

- 0 = asymmetrically placed } length
- 1 = symmetrically placed } 12,5 mm
- 2 = asymmetrically placed } length
- 3 = symmetrically placed } 16 mm

[1]) Only for tandem potentiometers.

resistance value ±20%	*code in catalogue number*				
	lin. law	*log. law*	*reversed log. law*	*semi log. law*	*balance*
220 Ω	02 [1]				
470 Ω	03 [1]				
1 kΩ	04	24 [1]	44 [1]	63 [2]	
2,2 kΩ	05	25 [1]	45 [1]	64 [2]	
4,7 kΩ	06	26 [1]	46 [1]	65 [2]	
10 kΩ	07	27	47 [2]	66 [2]	
22 kΩ	08	28	48 [2]	67	87
47 kΩ	09	29	49 [2]	68	88
100 kΩ	11	31	51 [2]	69	89
220 kΩ	12	32	52 [2]	71	91
470 kΩ	13	33	53 [2]	72	92
1 MΩ	14	34	54 [2]	73	93
2,2 MΩ	15	35	55 [2]	74	94
4,7 MΩ	16	36	56 [2]	75	95
10 MΩ	17 [1]			76	96
300 Ω	19 [1]				

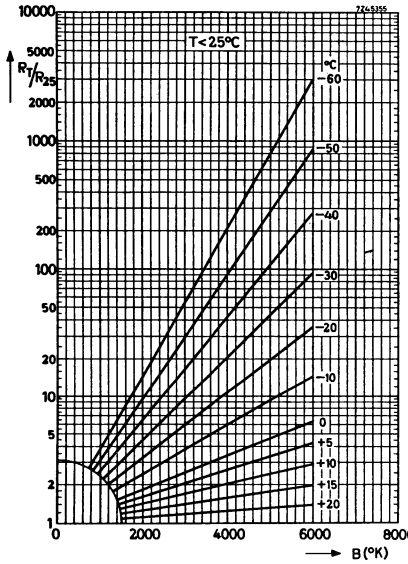
[1]) Only available without tap.
[2]) Only available without tap and with tap at 1/3 of the total travel.

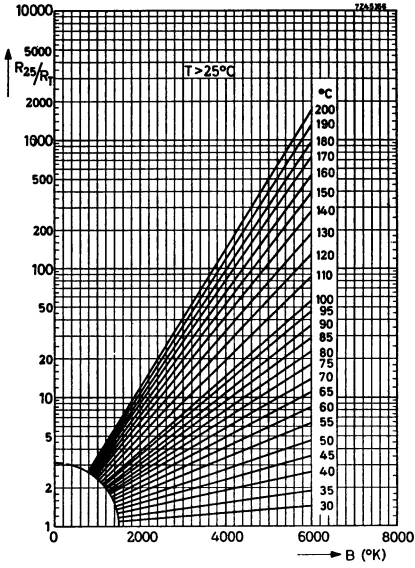
NTC THERMISTORS

NTC thermistors are resistors with a high negative temperature coefficient of resistance. The relation between resistance and temperature can be approximated by:

$$R = A\,e^{B/T}$$

where R is the resistance value at an absolute temperature T, A and B being constants for a given resistor and e the base of the natural logarithm ($e = 2.718$).



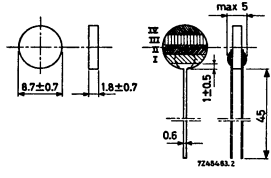


Standard disc types

Catalog number 2322 610 . . . . .
For the suffix of this number see table.

Maximum dissipation	1 W
Maximum temperature	120°C
Dissipation factor	10 mW/deg C
Thermal time constant	60 s

International colour code for resistors.



R_{25} ±20% (Ω)	*B-value* ±5% *at 25°C* (*K*)	*suffix of catalog number*	
		without leads	*with leads*
2.2	2650	01228	11228
4	2800	01408	11408
6	2800	01608	11608
8	2900	01808	11808
10	2950	01109	11109
12	2950	01129	11129
15	3000	01159	11159
33	3250	01339	11339
50	3300	01509	11509
82	4400	01829	11829
130	4600	01131	11131
500	5200	01501	11501
1300	5450	01132	11132

Types for motor cars

This range of discs has been developed for temperature sensors for the cooling water in motor cars. They are also suitable for temperature control in household appliances, such as washing machines.

R_{25} (Ω)	R_{40} (Ω)	R_{50} (Ω)	$R_{96.5}$ (Ω)	R_{100} (Ω)	*diameter (mm)*	*catalog number*
2200	1030–1310		147–173		7.0	2322 611 90003
500		175 –215		35 –43	6.9	90013
500		92.5–134		12 –15	6.9	90001
1000		221.5–318.5		30 –36	6.9	90004
270		97 –143		29.5–36.5	6.9	90009
700		207 –264		41.4–48.6	6.9	90011
800		244 –315		48.0–58.6	6.9	90008

application	R_{25} (Ω)	*B at 25°C approx.* (*K*)	$W_{max.}$ (*W*)	*normal operating conditions* (*mA*)	(Ω)	*dissipation factor approx.* (*mW/deg C*)	*max. diameter* (*mm*)	*max. body length* (*mm*)	*catalog number*
compensation	1.1 ± 20%	2650	1	2200	0.15–0.25	14	9	21	2322 619 90002
positive temperature coeff. of deflection coils	32 ± 30%/−20%	4200	1	1000	0.7–1.1	14	9	21	619 90003
	6 ± 20%	2800	1	1000	~1	10			2322 610 *
	10 ± 20%	2950	1	900	~1.1	10			610 *
	12 ± 20%	2950	1	800	~1.2	10			610 *
	15 ± 20%	3000	1	800	~1.2	10			610 *
	33 ± 20%	3250	1	700	~1.4	10			610 *
heater chain protection	300 – 500	3700	2.5	300	25–32	30	13	23	622 90005
	645 – 1210	3600	5	300	35–48	60	13	37	622 90004
	2470 – 5370	4000	4	300	38–50	24	11	37	622 90001
protection of switch and Si-diode	82 ± 20%	4650		1700	< 0.85	19	16		2322 644 9004
	⩾ 15	3350		2200	< 1	17	16		644 9005

* See Standard disc types 2322 610

NTC THERMISTORS

Miniature types

Miniature NTC thermistors are available in 7 versions all built around the same NTC-bead. The range of resistance values and the resistance temperature characteristics for all versions are the same.

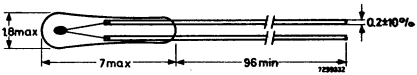
versions	*max. body dimensions mm*	*terminations at*		*catalog number*
		one side	*two sides*	
naked bead	1 ∅		×	2322 634 01 . . .
naked bead	1 ∅	×		2322 634 11 . . .
glass encapsulated bead	12 × 2.5		×	2322 634 21 . . .
vacuum mounted	31 × 6	×		2322 634 31 . . .
vacuum gauge	87 × 6	×		2322 634 41 . . .
thermometer	33 × 2.5	×		2322 627 11 . . .
thermometer	5 × 1.5	×		2322 627 21 . . .

R_{25} ±10% (Ω)	*B-value* ±5% *at* 25°C (*K*)	*catalog number suffix*	R_{25} ±10% (Ω)	*B-value* ±5% *at* 25°C (*K*)	*catalog number suffix*
1000	2350	102	33000	3750	333
1500	2450	152	47000	3800	473
2200	2600	222	68000	3850	683
3300	2775	332	100000	3900	104
4700	3650	472	150000	3975	154
6800	3725	682	220000	4075	224
10000	3800	103	330000	4175	334
15000	3750	153	470000	4225	474
22000	3800	223	680000	4300	684

Maximum dissipation	60 mW
Maximum temperature	200°C
Dissipation factor	approximately 0.4 mW/deg C
Stability after 1000 hrs at T_{max}	<1%
International colour code for resistors	

Miniature type 2322 627 3 . . . . .

For high temperature control



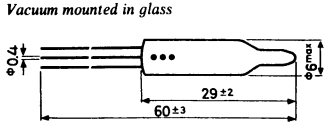
R_{25} ±20% (Ω)	$B_{25/85}$ ±5% (K)	*catalog number*
100 000	3800	2322 627 31104
150 000	3850	31154
220 000	3850	31224
330 000	3900	31334
470 000	3950	31474
680 000	3975	31684
1 000 000	4025	31105

Maximum dissipation	0.1 W
Dissipation factor	approx. 0.95 mW/deg C
Operating temperature range	
at zero power	−55 to +300°C
at max. power	0 to +55°C

NTC THERMISTORS

Indirectly heated types

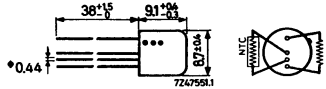
Vacuum mounted in glass



catalog number	2322 628 01332,	2322 628 01334
R_{25}	3300 Ω ± 20 %	330 kΩ
B-value	2775 K ± 10 %	4175 K ± 10 %
Colour code	orange-orange-red	orange-orange-yellow

$W_{max.}$ heater	30 mW
$T_{max.}$	200 °C
Resistance heater	100 Ω ± 10 %
$W_{max.}$ NTC	25 mW
Dissipation factor	0.18 mW/deg C
Heater efficiency	97.5 %
Thermal time constant	2.2 s
Dielectric strength heater/bead	⩾ 200 V

Mounted in air-filled metal casing

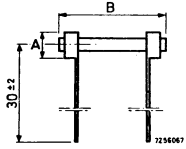


catalog number	2322 628 11332	2322 628 11334
R_{25}	3300 Ω ± 20 %	330 kΩ
B-value	2775 K ± 5 %	4175 K ± 5 %
Colour code	orange-orange-red	orange-orange-yellow

$W_{max.}$ heater	80 mW
$T_{max.}$	125 °C
Resistance heater	100 Ω ± 10 %
$W_{max.}$ NTC	60 mW
Dissipation factor	0.50 mW/deg C
Heater efficiency	90 %
Thermal time constant	1.2 s
Dielectric strength heater/bead	⩾ 200 V

Standard rod types

Dimensions in mm



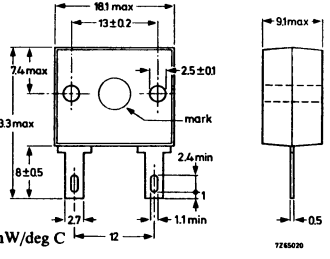
series	*A*	*B*
2322 635	3.2±0.5	11±1
2322 636	4.7±0.5	21±1
2322 637	6.2±0.5	31±1

R_{25} ±20% (kΩ)	*B-value* ±5% *at 25°C (K)*	$W_{max.}$ *at 25°C amb (W)*	*dissipation factor (mW/deg C)*	*thermal time constant (s)*	*colour code*	*catalog number*
4.7	3250	0.6	5.5	28	orange	2322 635 01472
15	3550				green	153
47	3925				blue	473
150	4075				white	154
330	4200				yellow/blue	334
4.7	3250	1.5	12	55	orange	2322 636 01472
15	3550				green	153
47	4000				blue	473
150	4150				white	154
4.7	3250	2.3	17	105	orange	2322 637 01472
15	3650				green	153
47	4050				blue	473
150	4200				white	154

Maximum temperature 150°C

Stability ΔR_{25} after 1000 hrs at $W_{max.}$ <5%

ΔR_{25} after 1000 hrs at $\frac{2}{3}$ $W_{max.}$ <3%



R at −10°C 5000 Ω±4.5%

R at −30°C 13350 Ω±5%

$B_{25/85}$-value 3425 K

Temperature coefficient at 25°C −4%/deg C

Max. dissipation at T_{amb}=25°C 0.5 W

Dissipation factor (on a heat-sink) 25 mW/deg C

Thermal time constant (on a heat-sink) 12 s

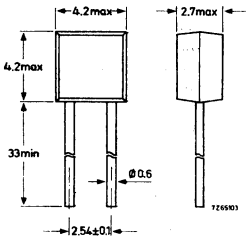
Operating temperature range at zero power −55 to +85°C

Catalog number 2322 640 90001

NTC THERMISTORS

MOULDED TYPE

Catalog number	2322 640 90002	2322 640 90003
Resistance value at $T = -30°C$		13350 Ω ± 5%
$T = -20°C$	8600 Ω ± 8%	8000 Ω ± 4%
$T = -10°C$		5000 Ω ± 4.5%
$T = -0°C$	3500 Ω	
$T = +25°C$	1215 Ω ± 7%	
Operating temperature range at zero power	−25 to +85°C	−55 to +85°C
$B_{25/85}$-value	3425 K	
Temperature coefficient at 25°C	−3.9%/deg C	
Maximum dissipation	0.25 W	
Dissipation factor	6.3 mW/degC	
(on a heat-sink)	12.5 mW/degC	
Thermal time constant	17 s	
(on a heat-sink)	7 s	



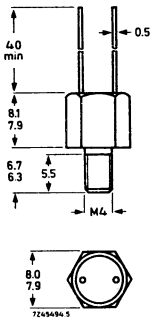
R_{25} $\pm 20\%$ (Ω)	$B_{25/85}$ (K)	*dissipation factor* (*mW/deg C*)	*thermal time constant* (*s*)	*catalog number*
3.3	2600	9	30	2322 642 11338
4.7	2665	9	30	11478
6.8	2730	9	30	11688
10	2800	9	30	11109
15	2870	9	30	11159
22	2935	9	25	11229
33	3010	9	25	11339
47	3070	9	25	11479
68	3125	8	25	11689
100	3200	8	25	11101
150	3280	8	25	11151
220	3350	8	25	11221
330	3440	8	25	11331
470	3520	8	25	11471
680	3600	8	25	11681
1000	3680	8	25	11102
1500	3775	8	25	11152
2200	3915	8	25	11222
3300	4070	8	25	11332
4700	4200	8	25	11472
6800	4300	8	25	11682
10000	4400	8	25	11103
15000	4375	8.5	25	11153
22000	4200	8.5	25	11223
33000	4250	8.5	25	11333
47000	4325	8.5	25	11473
68000	4375	8.5	25	11683
100000	4200	8.5	25	11104
150000	4600	8.5	25	11154
220000	4650	8.5	25	11224
330000	4700	8.5	25	11334

Max. dissipation at 55°C	0.5 W
Operating temperature range at zero power	−25 to +125°C
International colour code for resistors	

NTC THERMISTORS

Standard disc type (2322 642 1 . . . .) with mounting stud

Dissipation factor	
without heatsink	9.5 mW/degC approx.
mounted on a heatsink of 1 dm^2, thickness 1.5 mm	19 mW/degC approx.
Thermal time constant	
without heatsink	80 s approx.
mounted on a heatsink of 1 dm^2, thickness 1.5 mm	15 s approx.
Max. dissipation at 55°C	0.5 W
Operating temperature range at zero power	−25 to +100 °C
Dielectric withstanding voltage	>100 V
Insulation resistance	>100 MΩ



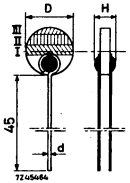
Dimensions in mm

R_{25} ±20% (Ω)	$B_{25/85}$ (K)	*catalogue number*	R_{25} (Ω)	$B_{25/85}$ (K)	*catalogue number*
3.3	2600	2322 642 21338	1500	3775	2322 642 21152
4.7	2665	21478	2200	3915	21222
6.8	2730	21688	3300	4070	21332
10	2800	21109	4700	4200	21472
15	2870	21159	6800	4300	21682
22	2935	21229	10000	4400	21103
33	3010	21339	15000	4375	21153
47	3070	21479	22000	4200	21223
68	3125	21689	33000	4250	21333
100	3200	21101	47000	4325	21473
150	3280	21151	68000	4375	21683
220	3350	21221	100000	4200	21104
330	3440	21331	150000	4600	21154
470	3520	21471	220000	4650	21224
680	3600	21681	330000	4700	21334
1000	3680	21102			

Standard disc types

Dimensions in mm

series	*D*	H_{max}	*d*
2322 643	9 ± 0.5	6	0.6
2322 644	16 ± 0.5	7	0.8



R_{25} $\pm 20\%$ (Ω)	*B-value at 25°C* (*K*)	P_{max} *at* $T_{amb} = 25°C$ (*W*)	*dissipation factor* (*mW/deg C*)	*thermal time constant* (*s*)	*catalog number*
150	3400	1	10	55	2322 643 11151
470	3800	1	10	55	11471
1500	4100	1	10	55	11152
4700	4200	1	10	55	11472
150	3400	1.5	13	120	2322 644 11151
470	3900	1.5	13	120	11471
1500	4050	1.5	13	120	11152
4700	4200	1.5	13	120	11472

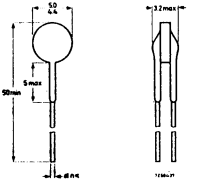
Operating temperature range at zero power -25 to $+125°C$

International colour code for resistors

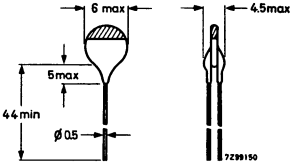
PTC THERMISTORS

DISC TYPE

Resistance at 25°C	250 Ω ± 25%
Switch temperature at 80°C	3700 Ω ± 30%
Temperature coefficient	+5%/degC
Max. voltage at $T_{amb} = +55°C$	25 V d.c.
Dissipation factor	6 mW/degC
Operating temperature range	
at zero power	−25 to +155°C
at V_{max}	0 to +55°C
Catalog number	2322 660 91001



Standard disc type



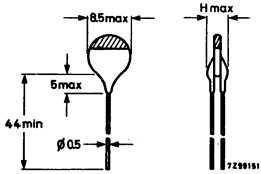
R_{25} ±30% (Ω)	R_{125} (kΩ)	R_{150} (MΩ)	T_s[1]) approx. (°C)	max. temp. coeff. (%/deg C)	colour code	catalog number
60	3– 15		+ 30	+ 7	red	2322 660 91006
50	100–500		+ 50	+16	orange	91007
50	50–500		+ 80	+23	yellow	91008
50		0.1–1.2	+105	+40	green	91009

Maximum voltage 25 $V_{d.c.}$
Dissipation factor: approx. 7 mW/deg C
The above resistance values are measured at 1.5 V[2])

[1]) The switch temperature T_s is the higher of the two temperatures at which the resistance is twice the minimum resistance.

[2]) Higher voltages may yield different values due to self-heating and voltage-dependency.

Standard disc type



For 2322 661 90005 $H_{max} = 5.5$ mm
For other types $H_{max} = 6.5$ mm

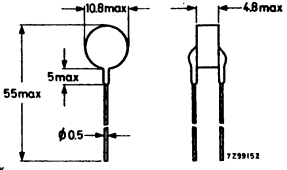
R_{25} ±15 (Ω)	*R at other temperatures*		T_s[1]) *approx.* (°C)	*max. temp. coeff.* (%/deg C)	$V_{max.}$ ($V_{d.c.}$)	*colour code*	*catalog number*
50	60°C	< 100 Ω	+80	+18	50	yellow	2322 661 91002
	100°C	> 1 kΩ					
40	95°C	< 80 Ω	+110	+75	50	green	2322 661 91003
	130°C	> 10 kΩ					
30	40°C	< 90 Ω	+45	+16	50	orange	2322 661 91004
	100°C	> 10 kΩ					
50	100°C	3–20 kΩ	+25	+9	40	red	2322 661 91005

Dissipation factor: approx. 10 mW/deg C
The above resistance values are measured at 1.5 V[2])
[1]) The switch temperature T_s is the higher of the two temperatures at which the resistance is twice the minimum resistance.
[2]) Higher voltages may yield different values due to self-heating and voltage-dependency.

PTC THERMISTORS

PTC thermistor 2322 662 91001

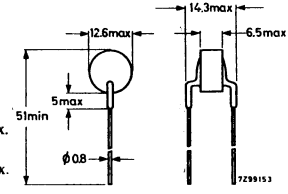
Resistance value at +25 °C	36 to 50 Ω
Resistance value at +165 °C	
V_{pulse} = 180 V	>20 kΩ
Switch temperature	115 °C approx.
Temperature coefficient	35 %/deg C approx.
Max. voltage	180 $V_{d.c.}$
Dissipation factor	13 mW/deg C approx.
Operating temperature range	
at zero power	0 to +155 °C
at V_{max}	0 to +55 °C



For the protection of telegraphy relay contacts

PTC thermistor 2322 662 93036

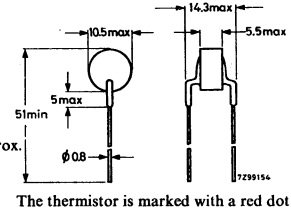
Resistance value at + 25 °C	45 to 60 Ω
Resistance value at +150 °C	
V_{pulse} = 340 V	>45 kΩ
Switch temperature	+75 °C approx
Temperature coefficient	+23 %/deg C approx.
Max. voltage at T_{amb} < +60 °C	265 V_{rms}
Dissipation factor	17 mW/deg C approx.
Operating temperature range	
at zero power	0 to +155 °C
at V_{max}	0 to +60 °C



For use in the degaussing circuit of colour TV sets

PTC thermistor 2322 662 93066

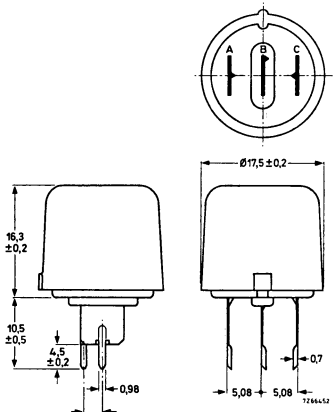
Resistance value at +25 °C	100 Ω ± 20 %
Resistance value at +150 °C	
V_{pulse} = 340 V	>40 kΩ
Switch temperature	80 °C
Max. voltage at T_{amb} < +60 °C	265 V_{rms}
Dissipation factor	15.3 mW/deg C approx.
Operating temperature range	
at zero power	0 to +150 °C
at V_{max}	0 to +60 °C



The thermistor is marked with a red dot
For use in the degaussing circuit of colour TV sets

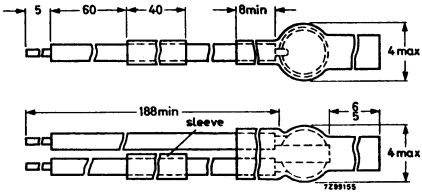
Dual PTC thermistors 2322 662 98001
2322 662 98003

To be used in the degaussing circuit of colour television sets.



	2322 662 98001	2322 662 98003
min. inrush current	200 V r.m.s.	220 V r.m.s.
max. idle peak current	5 A	5 A
after 5 s	70 mA	70 mA
after 30 s	5 mA	5 mA
after 3 min	2 mA	2 mA
Resistance at +25°C:		
of mains PTC	25 Ω	30 Ω
of coil PTC	8 Ω	8 Ω
at T_{amb} = +175°C and 375 V pulsed		
of mains PTC	≧32 kΩ	≧35 kΩ
at T_{amb} = +155°C		
of coil PTC	≧20 kΩ	≧20 kΩ
Switch temperature of mains and coil PTC	75°C	75°C
Temperature coefficient		
of mains PTC	23%/deg C	25%/deg C
of coil PTC	25%/deg C	25%/deg C
Maximum voltage in circuit	245 V r.m.s.	265 V r.m.s.
Dissipation factor	13,5 mW/deg C	
Operating temperature range		
at zero power	−25 to +155°C	
at maximum voltage	0 to + 60°C	

PTC thermistor for motor protection



Resistance value at -20 and $T_{ref}-10$ °C	20 to 150 Ω
Resistance value at $T_{ref}+15$ °C	
$V_{pulse}=15$ V	>3500 Ω
Max. voltage	15 V
Dissipation factor	7 mW/deg C approx.
Operating temperature range	
at zero power	-25 to $T_{ref}+30$ °C
at V_{max}	-25 to $T_{ref}+15$ °C

T_{ref} [1] (°C)	T_s (°C)	*temperature coefficient %/deg C*	*catalogue number*
80	68	18	2322 672 92045
90	75	21	92046
100	88	31	92047
110	99	33	92048
120	113	38	92049
130	123	27	92051
140	130	33	92052
150	137	33	92053

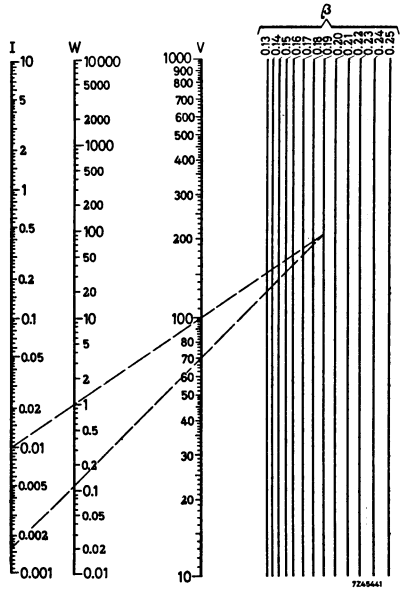
[1]) The temperature at which the thermistor has to make the protection system operative.

VOLTAGE DEPENDENT RESISTORS

The relation between voltage and current of a VDR resistor can be approximated by:

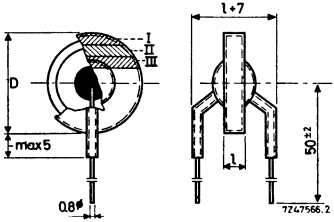
$$V = C \cdot I^{\beta} \qquad (1)$$

where V is the voltage in volts, I the current in amperes and C and β are constants. This equation is illustrated in the figure on next page.



Nomogram giving the relation between voltage, current, power dissipation and β-value of any VDR.

Standard disc types with leads

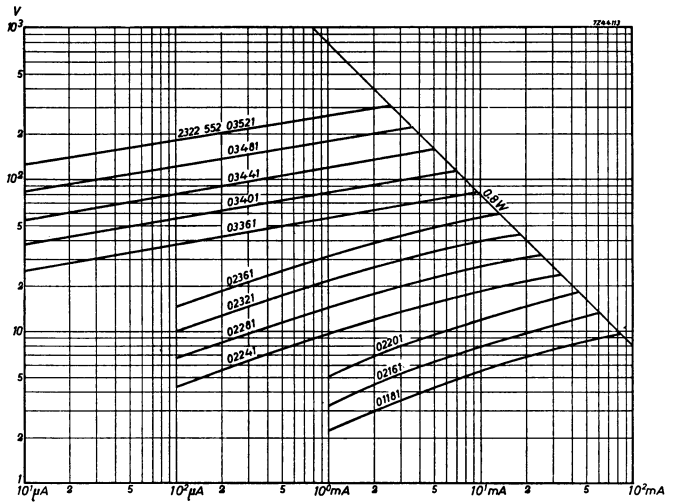


Tolerance on voltage is $\pm 20\%$.

Temperature range:
at zero power -25 to $+125$°C
at max. power 0 to $+55$°C
Tolerance on voltage $\pm 20\%$

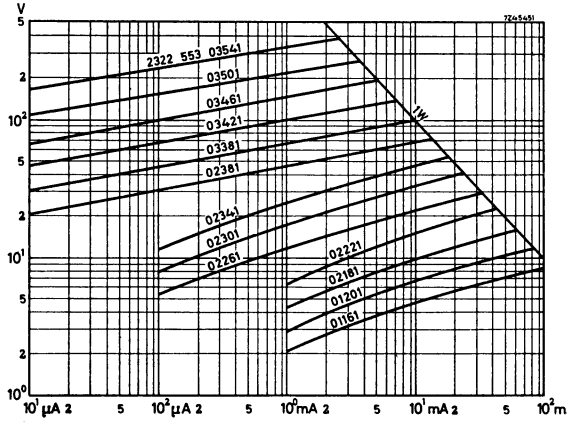
VOLTAGE DEPENDENT RESISTORS

$W_{max.} = 0.8$ W
$D_{max.} = 14.5$ mm



I (*mA*)	*E* (*V*)	*β*	*C* *approx.*	$l_{max.}$ (*mm*)	*colour code* *I*	*II*	*III*	*catalog number*
100	10	0.25–0.40	18	5	brown	brown	grey	2322 552 01181
10	8	0.25–0.40	25	5	red	brown	blue	02161
10	12	0.25–0.40	40	5	red	red	black	02201
10	18	0.21–0.35	57	5	red	red	yellow	02241
10	27	0.21–0.35	70	5	red	red	grey	02281
10	39	0.18–0.25	100	5	red	orange	red	02321
10	56	0.18–0.25	150	5	red	orange	blue	02361
1	56	0.14–0.23	190	5	orange	orange	blue	03361
1	82	0.14–0.21	300	5	orange	yellow	black	03401
1	120	0.14–0.21	400	6	orange	yellow	yellow	03441
1	180	0.14–0.21	600	7	orange	yellow	grey	03481
1	270	0.14–0.21	900	8	orange	green	red	03521

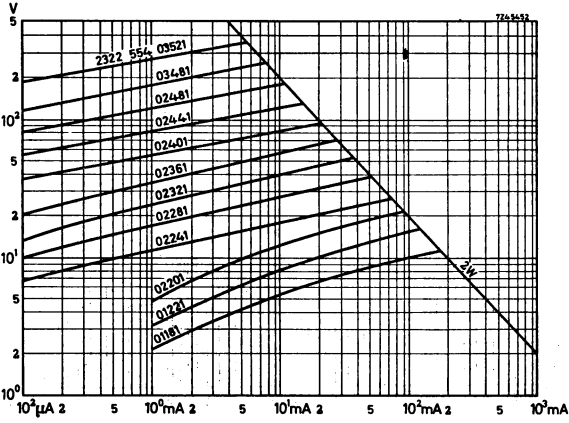
$W_{max.} = 1$ W
$D_{max.} = 20$ mm



I (*mA*)	*E* (*V*)	*β*	*C* *approx.*	$l_{max.}$ (*mm*)	*colour code* *I*	*II*	*III*	*catalog number*
100	8	0.25–0.40	14	5	brown	brown	blue	2322 553 01161
100	12	0.25–0.40	21	5	brown	red	black	01201
10	10	0.25–0.40	32	5	red	brown	grey	02181
10	15	0.25–0.40	48	5	red	red	red	02221
10	22	0.21–0.35	60	5	red	red	blue	02261
10	33	0.18–0.25	85	5	red	orange	black	02301
10	47	0.18–0.25	130	5	red	orange	yellow	02341
10	68	0.18–0.25	180	5	red	orange	grey	02381
1	68	0.14–0.23	230	5	orange	orange	grey	03381
1	100	0.14–0.21	350	5.5	orange	yellow	red	03421
1	150	0.14–0.21	500	6.5	orange	yellow	blue	03461
1	220	0.14–0.21	750	7.5	orange	green	black	03501
1	330	0.14–0.21	1100	9	orange	green	yellow	03541

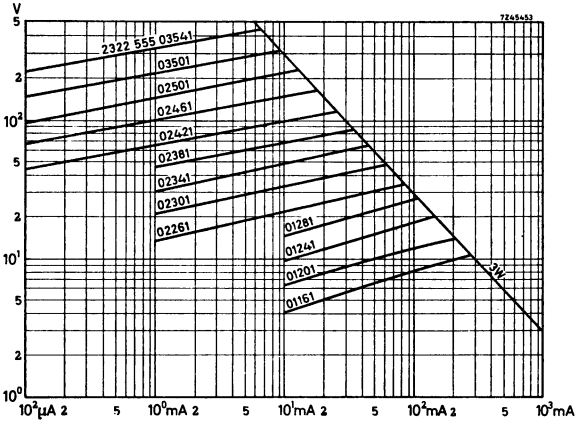
VOLTAGE DEPENDENT RESISTORS

$W_{max.} = 2$ W
$D_{max.} = 27.5$ mm



I (*mA*)	*E* (*V*)	*β*	*C* approx.	$l_{max.}$ (*mm*)	*colour code* I	II	III	*catalog number*
100	10	0.25–0.40	18	5	brown	brown	grey	2322 554 01181
100	15	0.25–0.40	26	5	brown	red	red	01221
10	12	0.25–0.40	38	5	red	red	black	02201
10	18	0.21–0.35	57	5	red	red	yellow	02241
10	27	0.21–0.35	70	5	red	red	grey	02281
10	39	0.18–0.25	97	5	red	orange	red	02321
10	56	0.18–0.25	140	5	red	orange	blue	02361
10	82	0.14–0.23	170	5	red	yellow	black	02401
10	120	0.14–0.21	250	5	red	yellow	yellow	02441
10	180	0.14–0.21	380	6	red	yellow	grey	02481
1	180	0.14–0.21	540	7	orange	yellow	grey	03481
1	270	0.14–0.21	810	8	orange	green	red	03521

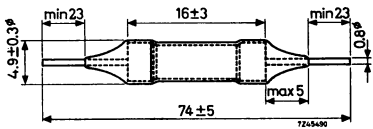
$W_{max.} = 3$ W
$D_{max.} = 42.5$ mm



I (*mA*)	*E* (*V*)	*β*	*C* *approx.*	$l_{max.}$ (*mm*)	*colour code* *I*	*II*	*III*	*catalog number*
100	8	0.25–0.40	14	5	brown	brown	blue	2322 555 01161
100	12	0.25–0.40	21	5	brown	red	black	01201
100	18	0.25–0.40	32	5	brown	red	yellow	01241
100	27	0.25–0.40	48	5	brown	red	grey	01281
10	22	0.21–0.35	60	5	red	red	blue	02261
10	33	0.18–0.25	84	5	red	orange	black	02301
10	47	0.18–0.25	125	5	red	orange	yellow	02341
10	68	0.18–0.25	175	5	red	orange	grey	02381
10	100	0.14–0.23	210	5	red	yellow	red	02421
10	150	0.14–0.21	320	5.5	red	yellow	blue	02461
10	220	0.14–0.21	460	6.5	red	green	black	02501
1	220	0.14–0.21	660	7.5	orange	green	black	03501
1	330	0.14–0.21	980	9	orange	green	yellow	03541

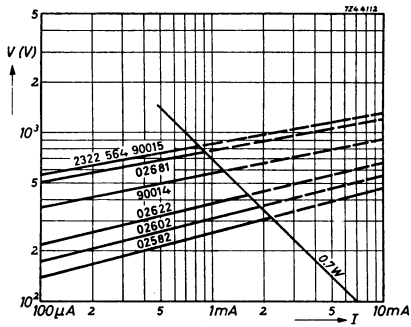
VOLTAGE DEPENDENT RESISTORS

Standard rod types



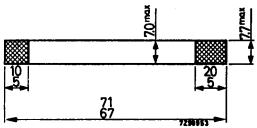
$W_{max.} = 0.7$ W

I (*mA*)	*E* (*V*)	*β*	*colour code*	*catalog number*
10	470 ± 10%	0.20–0.25	green	2322 564 02582
10	560 ± 10%	0.18–0.23	blue	02602
10	680 ± 10%	0.18–0.23	violet	02622
10	910 ± 10%	0.18–0.23	white	90014
10	1200 ± 20%	0.17–0.22	grey	02681
10	1300 ± 10%	0.16–0.21	red	90015
1	300 ± 20%	0.18–0.25	yellow	90016
2	950 ± 10%	0.16–0.21	black/blue	90005



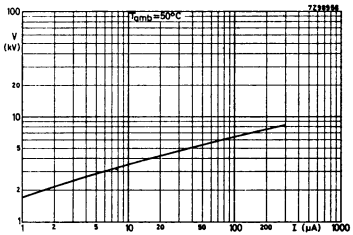
Rod type without leads, 2322 564 92003

For focus tracking in line time-base circuits of colour television sets.



Measurements and ratings are given at an ambient temperature of $+50°C+2°C$ unless otherwise stated.

Current at $V_{d.c.} = 7$ kV	100 to 150 μA
Maximum current	175 μA
β-value between 4 kV and 7 kV	0.17 to 0.25
Dissipation factor	22 mW/deg C
Operating temperature range	
at zero power	-25 to $+125°C$
at max. power	0 to $+50°C$

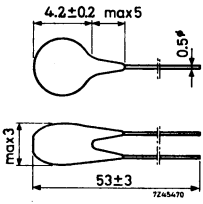


VOLTAGE DEPENDENT RESISTORS

Small disc types

For use in colour television

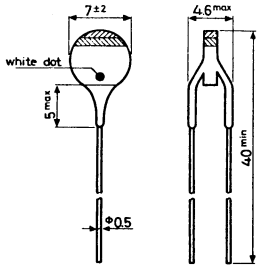
I (*mA*)	*E* (*V*)	*tolerance on voltage*	*catalog number*
1	6	±20%	2322 565 90002
1	9	±20%	90003
1	12	±15%	90004
1	15	±15%	90005
1	18	±12%	90006



Asymmetric types

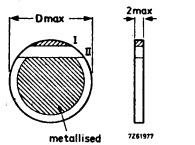
at $T_{amb}=25°C$		*catalog number*	
		2322 574 90001	2322 574 90002
forward direction	voltage at 1 mA	1.0 V±10%	1.35 V±10%
	temp. coeff.	> −0.2%/deg C	> −0.2%/deg C
	β	0.05–0.08	0.06–0.09
	capacitance at 0 mA	~0.15 μF	~0.15 μF
	at 5 mA	~10 μF	~10 μF
	max. permissible current	25 mA	20 mA
reverse direction	current at 5 V	<2 μA	<2 μA
	capacitance at 0 V	~0.15 μF	~0.15 μF
	at 5 V	~0.05 μF	~0.05 μF
	max. permissible voltage	5 V	5 V

Temperature range: −30 to +70°C
Cathode is indicated by a white dot.
Colour code 2322 574 90001 black and brown band
2322 574 90002 black and red band



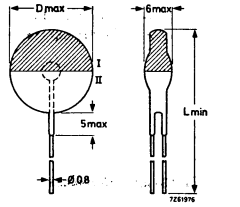
Disc types for contact protection

Marking
Discs without leads:
white colourband, (II) colour dot (I) indicates 10th digit of catalog number.
Discs with leads:
body colour (II) white, colourband (I) indicates 10th digit of catalog number.



Colour code:

0 = black 1 = brown 2 = red 3 = orange 4 = yellow 5 = green 6 = blue	$W_{max.}$ (*W*)	$L_{min.}$	*Catalog number prefix*	*Additional marking*
	0.25	58.5	2322 575	VAP3
	0.40	62	2322 576	VAP2
	1.0	65	2322 577	VAP1



These VDR's are developed for contact protection of relays in telephone exchanges.

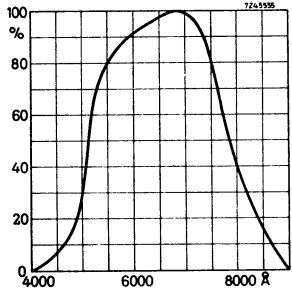
$V_{d.c.}$ (*V*)	*I* (*mA*)	V_{pulse} (*V*)	*I* (*mA*)	$W_{max.}$ (*W*)	$D_{max.}$ (*mm*)	*catalog number suffix* *without leads*	*with leads*
48	< 1.7	150	> 52	0.25	9.5	30272	00272
48	< 3	150	> 72	0.25	9.5	30372	00372
48	< 5	150	> 121	0.25	9.5	30472	00472
48	< 0.5	150	> 27	0.4	12.5	30072	00072
48	< 0.9	150	> 34	0.4	12.5	30172	00172
48	< 1.7	150	> 65	0.4	12.5	30272	00272
48	< 3	150	> 91	0.4	12.5	30372	00372
48	< 5	150	> 152	0.4	12.5	30472	00472
48	< 0.5	150	> 42	1	17	30072	00072
48	< 0.9	150	> 76	1	17	30172	00172
48	< 1.7	150	> 115	1	17	30272	00272
48	< 3	150	> 180	1	17	30372	00372
48	< 5	150	> 268	1	17	30472	00472
48	< 9	150	> 430	1	17	30572	00572
48	< 15	150	> 455	1	17	30672	00672

LIGHT DEPENDENT RESISTORS

The light dependent resistors are virtually small photoconductive cells, provided with two tinned copper connecting leads.
The relationship between resistance value and illumination can be expressed with good approximation by the formula:

$$R = AL^{-\alpha}$$

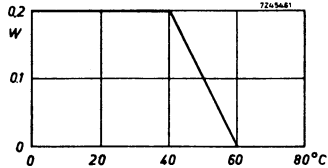
where R = resistance value in Ω
L = illumination in lux
A and α are constants



Spectral response characteristic of an LDR

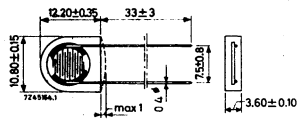
Electrical performance

dark value	>10 MΩ
light value	75–300 Ω
	(measured at 1000 lux)
recovery rate	>200 kΩ/s
permissible voltage	150 V_{peak}
capacitance	<6 pF

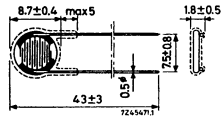


Permissible dissipation

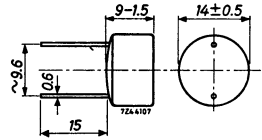
Version 2322 600 93001
This cell is sealed by means of a plastic coating
Ambient temperature range −30 to +60°C



Version 2322 600 94001
This cell is covered with lacquer.
Ambient temperature range −30 to +60°C



Version 2322 600 95001
Encapsulated in plastic case and synthetic resin
Ambient temperature range −20 to +60°C



STANDARD SERIES OF VALUES IN A DECADE

for resistances and capacitances according to I.E.C. publication 63

*E*192	*E*96	*E*48	*E*192	*E*96	*E*48	*E*192	*E*96	*E*48	*E*192	*E*96	*E*48	*E*192	*E*96	*E*48
100	100	100	169	169	169	284			481			816		
101			172			287	287	287	487	487	487	825	825	825
102	102		174	174		291			493			835		
104			176			294	294		499	499		845	845	
105	105	105	178	178	178	298			505			856		
106			180			301	301	301	511	511	511	866	866	866
107	107		182	182		305			517			876		
109			184			309	309		523	523		887	887	
110	110	110	187	187	187	312			530			898		
111			189			316	316	316	536	536	536	909	909	909
113	113		191	191		320			542			920		
114			193			324	324		549	549		931	931	
115	115	115	196	196	196	328			556			942		
117			198			332	332	332	562	562	562	953	953	953
118	118		200	200		336			569			965		
120			203			340	340		576	576		976	976	
												988		

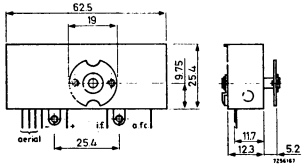
121	121	121	205	205	205	344			583						
123			208			348	348	348	590	590	590				
124	124		210	210		352			597						
126			213			357	357		604	604		E24	E12	E6	E3
127	127	127	215	215	215	361			612			10	10	10	10
129			218			365	365	365	619	619	619	11			
130	130					370			626			12	12		
132			221	221		374	374		634	634		13			
133	133	133	223			379			642			15	15	15	
135			226	226	226	383	383	383	649	649	649	16			
137	137		229			388			657			18	18		
138			232	232		392	392		665	665		20			
140	140	140	234			397			673			22	22	22	22
142			237	237	237	402	402	402	681	681	681	24			
143	143		240			407			690			27	27		
145			243	243		412	412		698	698		30			
147	147	147	246			417			706			33	33	33	
149			249	249	249	422	422	422	715	715	715	36			
150	150		252			427			723			39	39		
152			255	255		432	432		732	732		43			
154	154	154	258			437			741			47	47	47	47
156			261	261	261	442	442	442	750	750	750	51			
158	158		264			448			759			56	56		
160			267	267		453	453		768	768		62			
162	162	162	271			459			777			68	68	68	
164			274	274	274	464	464	464	787	787	787	75			
165	165		277			470			796			82	82		
167			280	280		475	475		806	806		91			

F.M. TUNERS

F.M. tuners AP2151/. .

type	*catalog number*
AP2151/00, F.M. tuner for European band	3122 108 68870
AP2151/01, F.M. tuner for American band	3122 107 13430

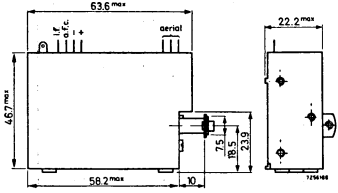
Supply voltage : 9 $V_{d.c.}$
Frequency range
AP2151/00 : 87–104 MHz
AP2151/01 : 87–108 MHz
Total gain AP2151/00 : 4.5 ×
AP2151/01 : 4 ×
Intermediate frequency : 10.7 MHz



F.M. tuners AP 2152/. .

type	*catalog number*
AP2152/00, F.M. tuner for European band; with soldering lugs	3122 108 69400
AP2152/01, as AP2152/00, but with pins for printed-wiring connection	3122 108 81760
AP2152/02, F.M. tuner for American band; with soldering lugs	3122 108 68730

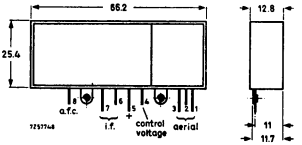
Supply voltage : 14 $V_{d.c.}$
Frequency range
AP2152/00 and AP2152/01 : 87–104 MHz
AP2152/02 : 87–108.9 MHz
Total gain : 4 ×
Intermediate frequency : 10.7 MHz



F.M. tuners with diode tuning AP 2153/...

type	*catalog number*
AP2153/01, F.M. tuner for European band	3122 108 86460
AP2153/02, F.M. tuner for American band	3122 108 89640

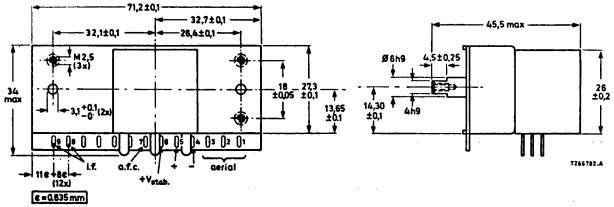
Supply voltage	: 15 $V_{d.c.}$
Frequency range	
AP2153/01	: 87–105 MHz
AP2153/02	: 87–108 MHz
Total gain	: 4 ×
Intermediate frequency	: 10.7 MHz



F.M. tuners AP 2154 ..

type	*catalogue number*
AP2154/01, F.M. tuner for European band	3122 137 10460
AP2154/02, F.M. tuner for American band	3122 137 10830

Supply voltage	: 9 V d.c.
Frequency range	
AP2154/01	: 87,5–104 MHz
AP2154/02	: 87,5–108 MHz
Total gain	: 14 dB
Intermediate frequency	: 10,7 MHz

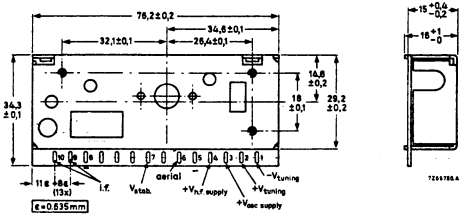


F.M. TUNERS

F.M. tuner with diode tuning AP 2155/01

F.M. tuner for European and American band, catalogue number 3122 137 11000

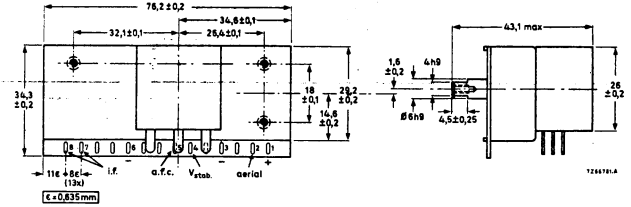
Supply voltage	:	7,5 V d.c.
Frequency range	:	87,5–108 MHz
Total gain	:	18 dB
Intermediate frequency	:	10,7 MHz



F.M. tuner AP 2156/01

F.M. tuner for European band, catalogue number 3122 137 10940

Supply voltage	:	5,25 V d.c.
Frequency range	:	87,5–104 MHz
Total gain	:	19 dB
Intermediate frequency	:	10,7 MHz



LOUDSPEAKERS

Standard range, round cone

width (mm) × height (mm)	*depth (mm)*	*max. power*	*resonance frequency*	*impedance*	*catalogue number*	*type number*	*main applications*
2½ in							
64 mm ∅	20	0.5 W	360 Hz	4 Ω	2422 257 23801	AD2070/Z4	
				8 Ω	2422 257 23802	Z8	portable sets
				15 Ω	2422 257 23803	Z15	intercom
				25 Ω	2422 257 23804	Z25	
3 in							
81 mm ∅	28	1 W	250 Hz	4 Ω	2422 257 23701	AD3070/Y4	
				8 Ω	2422 257 23702	Y8	portable sets
				15 Ω	2422 257 23703	Y15	intercom
				25 Ω	2422 257 23704	Y25	
81 × 81	28	1 W	250 Hz	150 Ω	2422 257 23705	AD3370/Y150	
4 in							
105 mm ∅	29	1 W	200 Hz	4 Ω	2422 257 24201	AD4070/Y4	
				8 Ω	2422 257 24202	Y8	portable sets
				15 Ω	2422 257 24203	Y15	
				25 Ω	2422 257 24204	Y25	
105 mm ∅	39	3 W	165 Hz	4 Ω	2422 257 34301	AD4080/X4	
			165 Hz	8 Ω	2422 257 34302	X8	
			165 Hz	15 Ω	2422 257 34303	X15	
			165 Hz	25 Ω	2422 257 34304	X25	portable sets
			185 Hz	4 Ω	2 22 257 34305	Z4	
			185 Hz	8 Ω	2422 257 34306	Z8	
			185 Hz	15 Ω	2422 257 34307	Z15	
			185 Hz	25 Ω	2422 257 34308	Z25	

LOUDSPEAKERS

width (mm) × height (mm)	*depth (mm)*	*max. power*	*resonance frequency*	*impedance*	*catalogue number*	*type number*	*main applications*
105 mm ∅	37	2 W	195 Hz	8 Ω	2422 256 34301	AD4090/X8	portable sets, television
		2 W	190 Hz	15 Ω	2422 256 34302	X15	
		0.6 W	190 Hz	400 Ω	2422 256 34303	X400	
5 in							
		3 W	155 Hz	4 Ω	2422 257 35201	AD5080/Z4	
				8 Ω	2422 257 35202	Z8	
				15 Ω	2422 257 35203	Z15	
				25 Ω	2422 257 35204	Z25	radio
129 mm ∅	48	6 W	130 Hz	4 Ω	2422 257 35205	X4	tape recorders
				8 Ω	2422 257 35206	X8	
				15 Ω	2422 257 35207	X15	record players
				25 Ω	2422 257 35208	X25	intercom
		4 W	130 Hz	4 Ω	2422 257 35209	M4	car radios
				8 Ω	2422 257 35211	M8	
				15 Ω	2422 257 35212	M15	
				25 Ω	2422 257 35213	M25	
6½ in							
166 mm ∅	56	6 W	110 Hz	4 Ω	2422 257 37801	AD7080/X4	radio
			110 Hz	8 Ω	2422 257 37802	X8	tape recorders
		4 W	105 Hz	4 Ω	2422 257 37803	M4	record players
			105 Hz	8 Ω	2422 257 37804	M8	
166 mm ∅	47	3 W	115 Hz	4 Ω	2422 256 37005	AD7091/X4	television
			95 Hz	4 Ω	2422 256 37004	M4	
			115 Hz	800 Ω	2422 256 37002	X800	
			95 Hz	800 Ω	2422 256 37001	M800	
			115 Hz	8 Ω	2422 256 37008	X8	
			95 Hz	8 Ω	2422 256 37009	M8	

8 in			95 Hz	4 Ω	2422 257 38201	AD8080/X4	
206 mm ∅	68	6 W	95 Hz	8 Ω	2422 257 38202	X8	radio
			75 Hz	4 Ω	2422 257 38203	M4	television
			75 Hz	8 Ω	2422 257 38204	M15	

Standard range, oval cone

3 in × 5 in				4 Ω	2422 256 30301	AD3590/X4	
				50 Ω	2422 256 30302	X50	portable sets
76 × 131	42	2 W	200 Hz	400 Ω	2422 256 30303	X400	television
				8 Ω	2422 256 30304	X8	
				15 Ω	2422 256 30305	X15	
3 in × 8 in				4 Ω	2422 257 30301	AD3880/X4	television
82 × 205	50	2 W	130 Hz	8 Ω	2422 257 30302	X8	tape recorders
				15 Ω	2422 257 30303	X15	portable sets
			120 Hz	4 Ω	2422 256 30501	AD3890/X4	radio,
82 × 205	54	2 W	120 Hz	8 Ω	2422 256 30503	X8	colour
			125 Hz	800 Ω	2422 256 30502	X800	television

LOUDSPEAKERS

width (mm) × height (mm)	*depth (mm)*	*max. power*	*resonance frequency*	*impedance*	*catalogue number*	*type number*	*main applications*
4 in × 6 in							
		3 W	155 Hz	4 Ω	2422 257 30201	AD4680/Z4	
				8 Ω	2422 257 30202	Z8	
				15 Ω	2422 257 30203	Z15	
				25 Ω	2422 257 30204	Z25	
103 × 154	48	6 W	140 Hz	4 Ω	2422 257 30205	X4	radio
				8 Ω	2422 257 30206	X8	tape recorders
				15 Ω	2422 257 30207	X15	record players
				25 Ω	2422 257 30208	X25	
		4 W	125 Hz	4 Ω	2422 257 30209	M4	
				8 Ω	2422 257 30211	M8	
				15 Ω	2422 257 30212	M15	
				25 Ω	2422 257 30213	M25	
				400 Ω	2422 256 30101	AD4690/M400	
				800 Ω	2422 256 30103	M800	
103 × 154	51	4 W	135 Hz	4 Ω	2422 256 30104	M4	
				4 Ω	2422 256 30105	X4	
				8 Ω	2422 256 30106	M8	
5 in × 7 in							
		3 W	115 Hz	4 Ω	2422 257 36101	AD5780/X4	
				8 Ω	2422 257 36102	X8	
				15 Ω	2422 257 36103	X15	radio
				25 Ω	2422 257 36104	X25	tape recorders
134 × 184	58			4 Ω	2422 257 36105	M4	records players
		4 W	100 Hz	8 Ω	2422 257 36106	M8	car radios
				15 Ω	2422 257 36107	M15	
				25 Ω	2422 257 36108	M25	

6 in × 9 in							
161 × 234	68	6 W	90 Hz	4 Ω	2422 257 39101	AD6980/X4	
			90 Hz	8 Ω	2422 257 39102	X8	radio
			77 Hz	4 Ω	2422 257 39103	M4	record players
			77 Hz	8 Ω	2422 257 39104	M8	

Tweeters, woofers and squawkers for Hi-Fi equipment

1 in dome tweeters							
94 mm ∅	27	20 W	1000 Hz	4 Ω	2422 257 33001	AD0160/T4	combinations
				8 Ω	2422 257 33002	T8	
2½ in tweeters							
58 mm ∅	29	10 W[1])	< 800 Hz	4 Ω	2422 257 22001	AD2071/T4	combinations
				8 Ω	2422 257 22002	T8	
5 in squawkers							
129 mm ∅	107	40 W	210 Hz	4 Ω	2422 257 35401	AD5060/Sq4	combinations
				8 Ω	2422 257 35402	Sq 8	
5 in woofers							
129 mm ∅	56	10 W[2])	50 Hz	4 Ω	2422 257 35301	AD5060/W4	enclosures
				8 Ω	2422 257 35302	W8	
7 in woofers							
166 m ∅	74	20 W[2])	28 Hz	4 Ω	2422 257 37702	AD7065/W4	enclosures
				8 Ω	2422 257 37701	W8	
8 in woofers							
205 mm ∅	85	20 W	34 Hz	4 Ω	2422 257 38401	AD8060/W4	enclosure
				8 Ω	2422 257 38402	W8	

[1]) With 5 μF in series of 8 Ω version and 12 μF of 4 Ω version.
[2]) In closed acoustic box.

LOUDSPEAKERS

width (mm) × height (mm)	*depth. (mm)*	*max. power*	*resonance frequency*	*impedance*	*catalogue number*	*type number*	*main applications*
206 mm ∅	93	20 W[2])	28 Hz	4 Ω 8 Ω	2422 257 38102 2422 257 38101	AD8065/W4 W8	enclosures
10 in woofers							
261 mm ∅	152	40 W[2])	20 Hz	4 Ω 8 Ω	2422 256 41201 2422 256 41202	AD1056/W4 W8	enclosures
261 mm ∅	113	30 W	20 Hz	8 Ω	2422 257 31302	AD1065/W8	enclosures
12 in woofers							
315 mm∅	133	30 W	20 Hz	4 Ω 8 Ω	2422 257 31201 2422 257 31202	AD1265/W4 W8	enclosures
315 mm ∅	169	40 W[2])	15 Hz	4 Ω 8 Ω	2422 256 41301 2422 256 41302	AD1256/W4 W8	enclosures

High quality full-range loudspeakers

5 in							
129 mm ∅	56	4 W	85 Hz	4 Ω 8 Ω	2422 257 35101 2422 257 35102	AD5060/M4 M8	enclosures
6½ in							
166 mm ∅	70	10 W	55 Hz	4 Ω 8 Ω	2422 257 37901 2422 257 37902	AD7061/M4 M8	enclosures

8 in							
205 mm ∅	95	10 W	70 Hz	4 Ω 8 Ω	2422 257 48001 2422 257 48002	AD8065/M4 M8	enclosures
8½ in							
217 mm ∅	116	10 W	50 Hz	7 Ω	2422 258 48002	9710M/01	enclosures
10 in							
261 mm ∅	113	10 W	55 Hz	4 Ω 8 Ω	2422 257 41001 2422 257 41002	AD1065/M4 M8	enclosures
12 in							
315 mm ∅	133	20 W	45 Hz	4 Ω 8 Ω	2422 257 41101 2422 257 41102	AD1265/M4 M8	enclosures
315 mm ∅	169	50 W	60 Hz	4 Ω 8 Ω	2422 256 51101 2422 256 51102	AD1256/HP4 HP8	guitar amplifiers electronic organs
315 mm ∅	169	25 W	45 Hz	4 Ω 8 Ω	2422 256 51001 2422 256 51002	AD1256/M4 M8	enclosures
315 mm ∅	151	50 W	60 Hz	4 Ω 8 Ω	2422 257 51101 2422 257 51102	AD12100/HP4 HP8	guitar amplifiers electronic organs
315 mm ∅	151	20 W	45 Hz	4 Ω 8 Ω	2422 257 51001 2422 257 51002	AD12100/M4 M8	enclosures

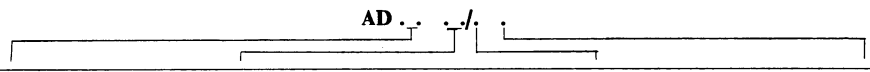
[1]) With 5 μF in series of 8 Ω version and 12 μF of 4 Ω version.
[2]) In closed acoustic box.

LOUDSPEAKERS

Recommended loudspeaker combinations

Woofer	*Squawker*	*Tweeter*	*Enclosure volume*	*Power handling capacity*	*Cross-over frequencies*
AD5060/W	—	AD0160/T	3 l	10 W	1000 Hz
AD5060/W	—	AD2070/T	3 l	10 W	2000 Hz
AD7065/W	—	AD0160/T	7 l	20 W	1500 Hz
AD8065/W	—	AD0160/T	15 l	20 W	1500 Hz
AD8065/W	AD5060/W	AD0160/T	25 l	20 W	700 Hz, 3000 Hz
AD1055/W	AD5060/W	AD0160/T	35 l	40 W	700 Hz, 3000 Hz
AD1055/W	2 × AD5060/W	2 × AD0160/T	40 l	40 W	700 Hz, 3000 Hz
AD1256/W	2 × AD5060/W	2 × AD0160/T	50 l	40 W	700 Hz, 3000 Hz
AD1256/W	4 × AD5060/W	4 × AD0160/T	80 l	40 W	700 Hz, 3000 Hz

Commercial coding system for our loudspeakers



size and shape (in)		*magnet system*[1])	*version*	*impedance (Ω)*
01 = 1	round	100 = Ferroxdure, 130 mm	Z = Notably higher sensitivity around a response peak at about 3 kHz	
10 = 10	round	90 = Sinterpot, Ticonal, 32 mm ∅		
12 = 12	round	80 = Ferroxdure, 53 mm ∅	Y = Notably higher response level in the region 2 to 6 kHz	
20 = 2¼ to 2½	round	70 = Ferroxdure, 30 mm ∅		
30 = 3	round	65 = Ferroxdure, 90 mm ∅	X = Same as Y, but a wider frequency range	
33 = 3	square	60 = Ferroxdure, 72 mm ∅		
35 = 3 × 5	oval	56 = Ticonal slug magnet, 112 mm ∅ for 50 mm coil	M = Smooth response over wide frequency range	
38 = 3 × 8	oval	55 = Ticonal ring magnet, 102 mm ∅ for 35 mm coil	W = Woofer, extremely low resonance frequency	
40 = 4	round	50 = Ticonal, 79 mm ∅	T = Tweeter, high frequency range	
44 = 4	square		HP = High power-handling capacity	
46 = 4 × 6	oval		Sq = Squawker; for midrange frequencies	
50 = 5	round			
57 = 5 × 7	oval			
69 = 6 × 9	oval			
70 = 6½	round			
80 = 8	round			

[1]) Mechanical or acoustical variations are indicated by replacing 0 or 5 by some other figure (91 = Sinterpot Wafer)

TELEVISION TUNERS

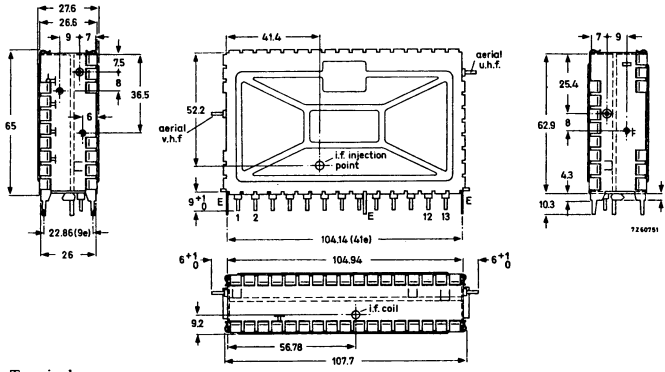
V.H.F./U.H.F. tuner with diode tuning ELC 2000S

Catalogue number	: 2422 542 12001
System	: C.C.I.R.
Semiconductors	
bands I and III	: BF200, BF182, BF194, 4 × BB106, 5 × BA182
bands IV and V	: BF180, BF181, 4 × BB105B
Supply voltage	: +12 V ±10%
A.G.C. voltage	
band I, at nominal gain	: 2.4 V
at 40 dB gain reduction	: 5.5 V, typical
band III, at nominal gain	: 2.4 V
at 40 dB gain reduction	: 4.5 V, typical
bands IV and V, at nominal gain	: 2.4 V
at 30 dB gain reduction	: 5.0 V, typical
Switching voltage	
band I	: open circuit
band III	: +12 V
bands IV and V	: +12 V
Tuning voltage range	: +0.3 to +28 V
Supply current	
band I	: 14 to 21 mA } depending
band III	: 34 to 41 mA } on a.g.c.
bands IV and V	: 31.5 to 38.5 mA } voltage
Frequency ranges	
band I	: channel 2 (picture carrier 48.25 MHz) to channel C (picture carrier 82.25 MHz).
band III	: channel 5 (picture carrier 175.25 MHz) to channel 12 (picture carrier 224.25 MHz).
bands IV and V	: channel 21 (picture carrier 471.25 MHz) to channel 69 (picture carrier 855.25 MHz).
Intermediate frequencies	
picture	: 38.9 MHz
sound	: 33.4 MHz
Aerial impedance, asymmetrical	: 75 Ω
symmetrical	: 300 Ω
Gain	
band I	: ⩾ 26 dB
channel 2	: 29 dB } typical values
channel C	: 32 dB } typical values
band III	: ⩾ 27 dB
channel 5	: 31 dB } typical values
channel 11	: 31 dB } typical values
bands IV and V	: ⩾ 25 dB
channel 21	: 28 dB } typical values
channel 51	: 32 dB } typical values
channel 68	: 31 dB } typical values

Noise figure

band I : ⩽ 9 dB
channel 4 : 6 dB typical value
band III : ⩽ 9 dB
channel 9 : 6 dB, typical value

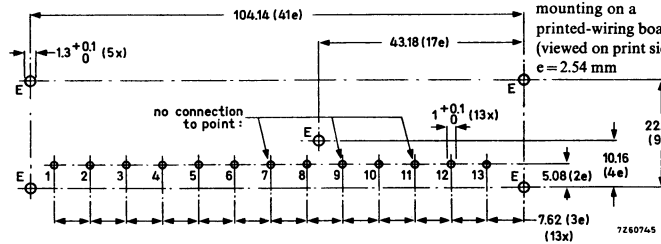
bands IV channels 21 to 60 : ⩽ 12 dB
and V, channels 61 to 68 : ⩽ 13 dB
channel 21 : 9.5 dB
channel 51 : 10 dB
channel 68 : 11 dB
} typical values



Terminal

1 = a.g.c. voltage, v.h.f., +2.4 to +7.5 V
2 = tuning voltage, +0.3 to +28 V
3 = switching voltage, +12 V
4 = r.f. supply voltage, v.h.f., +12 V
5 = oscillator supply voltage, v.h.f., +12 V
6 = mixer supply voltage, v.h.f., +12 V
7 = test point 1, v.h.f.
8 = i.f. output
9 = test point 2 (alignment short)
10 = oscillator supply voltage, u.h.f., +12 V
11 = test point 3, u.h.f.
12 = r.f. supply voltage, u.h.f., +12 V
13 = a.g.c. voltage, u.h.f., +2.4 to +7.5 V
E = earth

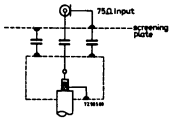
Hole pattern for mounting on a printed-wiring board (viewed on print side)
e = 2.54 mm

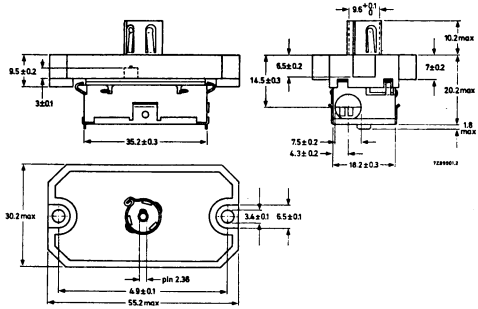


COAXIAL AERIAL INPUT ASSEMBLIES

Coaxial aerial input assembly 75 Ω

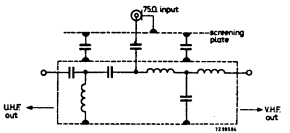
Attenuation : ⩽ 0.5 dB
Reflection, v.h.f. : ⩽ 10%
u.h.f. : ⩽ 25%
Catalogue number : 3122 127 10260

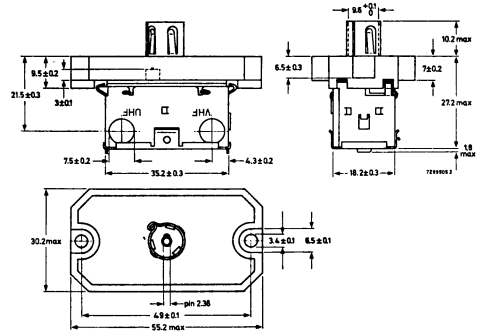




Coaxial aerial input assembly 75 Ω, with filter

Attenuation : ⩽ 0.6 dB
Reflection, v.h.f. : ⩽ 15%
u.h.f. : ⩽ 30%
Frequency characteristic
v.h.f. : 350 MHz, − 3 dB
470 MHz, −14 dB
700 MHz, −30 dB
u.h.f. : 400 MHz, − 3 dB
250 MHz, −15 dB
100 MHz, −40 dB
Catalogue number : 3122 127 10450





DEFLECTION COMPONENTS FOR BLACK AND WHITE TELEVISION

Deflection unit AT 1040

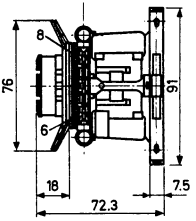
Catalogue number 3122 107 31380
For use with a 110° picture tube with a neck diameter of 28 mm in conjunction with the AT 2036/10, AT 2036/37 and the AT 4042/02.

Line deflection coils, parallel connected

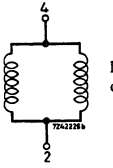
Inductance	2.1 mH
Resistance	3.9 Ω
Deflection current at 18 kV	2.82 A_{p-p}

Frame deflection coils, series connected

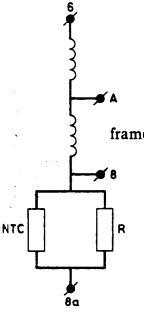
Inductance	66 mH
Resistance	30 Ω (6–8)
at 25°C	44 Ω (6–8a)
Deflection current	545 mA_{p-p}



Order of contacts
8, 8a, 2, 4, A, 6



line deflection coils



frame deflection coils

DEFLECTION COMPONENTS FOR BLACK AND WHITE TELEVISION

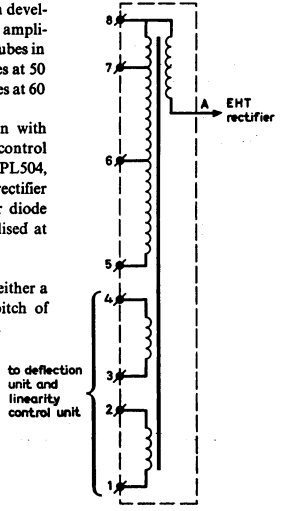
Line-output transformer AT 2036/10

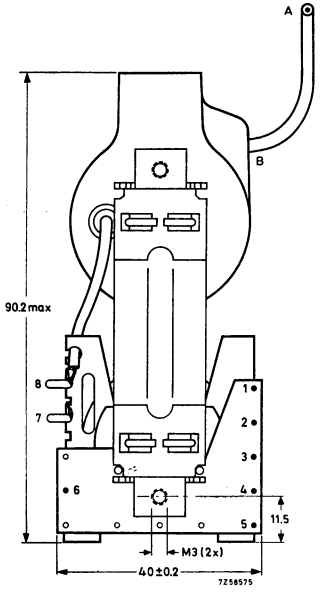
Catalogue number: 3122 138 30100

This line-output transformer has been developed to provide the required scanning amplitude for 17, 19, 20, 23 or 24 in picture tubes in television receivers presenting 625 lines at 50 frames per second (C.C.I.R.) or 525 lines at 60 frames per second (USA).

It is intended for use in conjunction with deflection unit AT 1040, linearity control unit AT 4042/02, line-output tube PL504, rectifying tube DY802 or selenium rectifier stack TV 18S or TV 20 and booster diode PY 88 or BY 147. The EHT is stabilised at 18 kV.

The transformer can be mounted on either a printed-wiring board (with a grid pitch of 2.54 or 2.50 mm) or on a metal chassis





mounting height = 66.5 mm
length A − B = 68 ± 3 mm

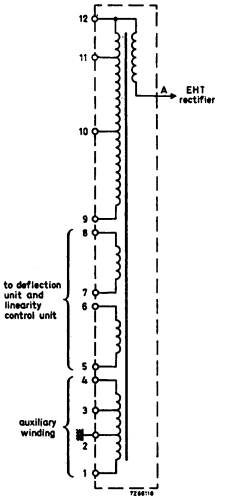
Line-output transformer AT 2036/37

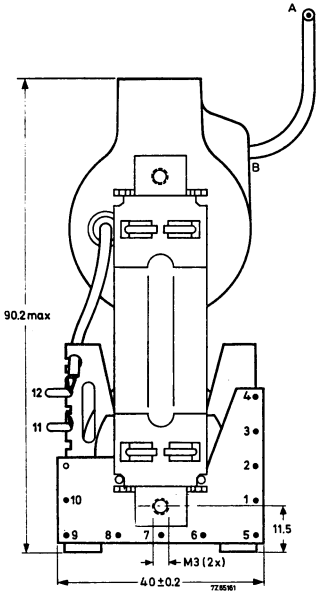
Catalogue number: 3103 108 30170

This line-output transformer has been developed to provide the required scanning amplitude for 17, 19, 20, 23 or 24 in picture tubes in television receivers presenting 625 lines at 50 frames per second (C.C.I.R.) or 525 lines at 60 frames per second (USA).

It is intended for use in conjunction with deflection unit AT 1040, linearity control unit AT 4042/02, line-output tube PL504, rectifying tube DY802 or selenium rectifier stack TV 18S or TV 20 and booster diode PY 88 or BY 147. The EHT is stabilised at 18 kV.

The transformer can be mounted on either a printed-wiring board (with a grid pitch of 2.54 or 2.50 mm) or on a metal chassis





mounting height = 66.5 mm
length A − B = 68 ± 3 mm

DEFLECTION COMPONENTS FOR BLACK AND WHITE TELEVISION

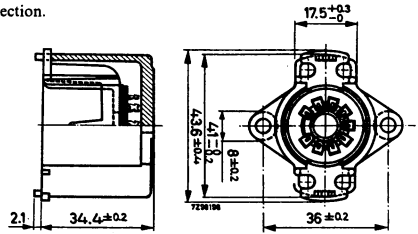
Adjustable linearity control unit AT 4042/02

Catalogue number: 3122 108 39450
For use in TV sets equipped with tubes, to adjust the linearity of the line deflection.
It can be used in combination with the AT 1040, AT 2036/10 or AT 2036/37.
For further data see section "Components for colour television".

E.H.T. tube sockets AT 7130 and AT 7130/01

These sockets for rectifier tube DY802 are equipped with a series resistor of 1.6Ω (AT 7130) or 1.2Ω (AT 7130/01) in the heater circuit.

Catalogue number of AT7130 : 3122 107 77950
of AT7130/01 : 3122 107 31240



COMPONENTS FOR COLOUR TELEVISION

Blue lateral unit AT 1025/05

Catalogue number: 3122 107 30020

For use with a 90° shadow mask colour picture tube in conjunction with a deflection unit AT 1027/.. or AT 1029/.. and a convergence unit AT 4045/.. or AT 4046/.. or AT 4050/.. for static and dynamic lateral adjustment.

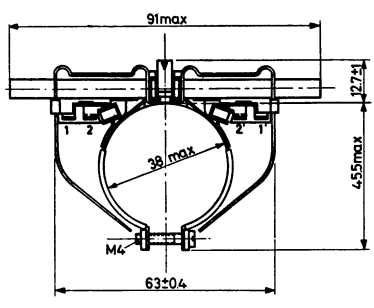
Coils, series connected (2 to 1')

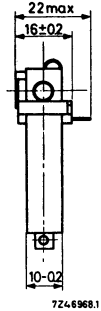
Inductance	3.2 mH
Resistance	36 Ω

Coils, parallel connected (1 to 1' and 2 to 2')

Inductance	0.63 mH
Resistance	9 Ω

The unit must be positioned on the colour picture tube as close as possible to the convergence unit.





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Blue lateral unit AT 1025/08

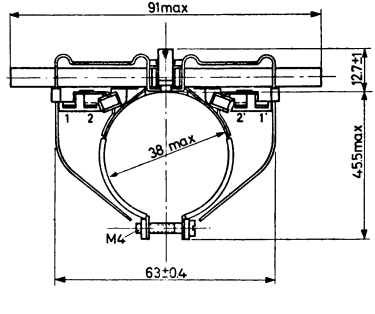
Catalogue number: 3122 137 11691

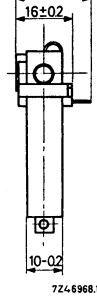
For use with a 90° shadow mask colour picture tube in conjunction with a deflection unit AT 1060/.. or AT 1062/.. and convergence unit AT 4045/.. or AT 4046/.. or AT 4050/.. for static and dynamic lateral adjustment.

Coils, parallel connected (1 to 1' and 2 to 2')

Inductance	0.3 mH
Resistance	3.2 Ω

The unit must be positioned on the colour picture tube as close as possible to the convergence unit.





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COMPONENTS FOR COLOUR TELEVISION

Deflection unit AT 1027/07

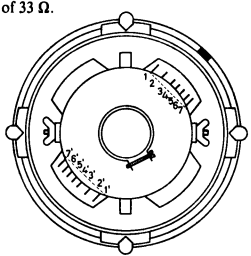
Catalogue number: 3122 137 10990

For use with a 90°, 22 in or 26 in shadow mask colour picture tube, in conjunction with line-output transformer AT 2053/. . or line-deflection transformer AT 2051/. . and E.H.T. transformer AT 2052 and convergence unit AT 4045/. . or AT 4046/. . or AT 4050/. ., blue lateral unit AT 1025/. . or AT 1065/. . or AT 1066/. ., linearity control unit AT 4042/. . and transductor AT 4041/. .

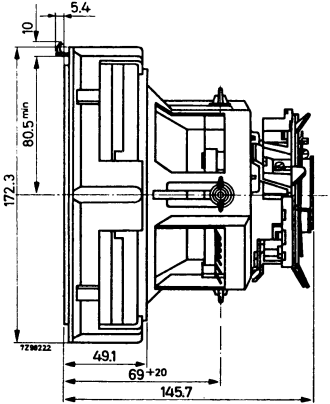
Electrical data

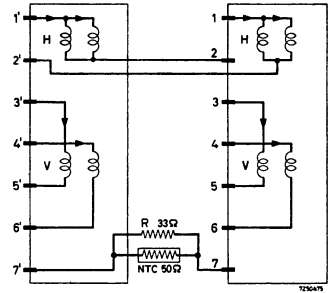
Line deflection coils, parallel connected	
Inductance	2.95 mH
Resistance at 25°C	2.9 Ω
Deflection current at 25 kV, edge to edge scan in both directions	2.6 A_{p-p}
Frame deflection coils, series connected	
Inductance	114 mH
Resistance at 25°C	56 + 20* Ω
Deflection current at 25 kV, edge to edge scan in both directions	0.415 A_{p-p}
Maximum working temperature	95°C

* NTC thermistor in parallel with a resistor of 33 Ω.



H = line coils
V = frame coils





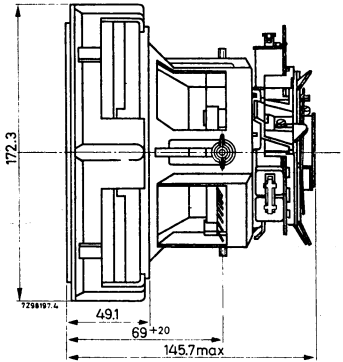
Deflection unit AT 1027/09

Catalogue number 3122 107 31520
For use with a 90°, 22 in or 26 in shadow mask colour picture tube, in conjunction with line-output transformer AT 2053/. . or line-deflection transformer AT 2051/. . and E.H.T. transformer AT 2052, and convergence unit AT 4045/. . or AT 4046/. . or AT 4050/. ., blue lateral unit AT 1025/. . or AT 1065/. . or AT 1066, linearity control unit AT 4042/. ., and transductor AT 4041/. .

Electrical data

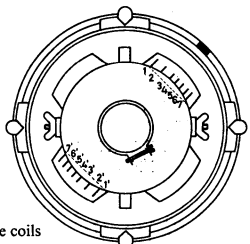
Line deflection coils, parallel connected	
Inductance	2.95 mH
Resistance at 25°C	2.9 Ω
Deflection current at 25 kV, edge to edge scan in both directions	2.6 Ap–p
Frame deflection coils, parallel connected	
Inductance	28 mH
Resistance at 25°C	14 + 4[1]) Ω
Deflection current at 25 kV, edge to edge scan in both directions	0.83 Ap–p
Maximum working temperature	95°C

[1])NTC thermistor in in parallel with a resistor of 12 Ω.



Deflection unit AT 1029/07

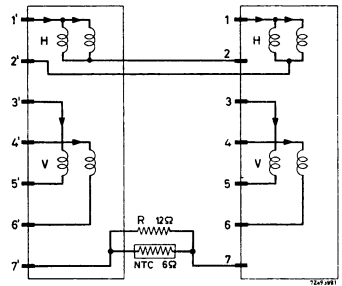
Catalogue number 3122 108 87890
For use with a 90°, 19 in or 22 in shadow mask colour picture tube.
For further data see AT 1027/07.



Deflection unit AT 1029/09

Catalogue number 3122 108 87900
For use with a 90°, 19 in or 22 in shadow mask colour picture tube.
For further data see AT 1027/09.

H = line coils
V = frame coils



COMPONENTS FOR COLOUR TELEVISION

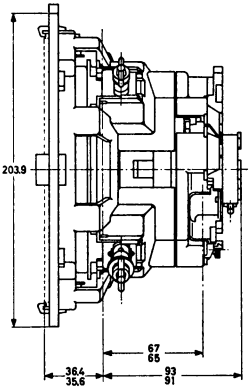
Deflection unit AT 1060/01 (with purity ring AT 1061)

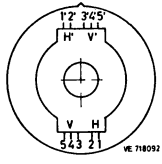
Catalogue number 3122 137 10670

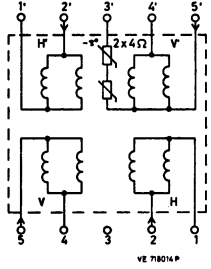
For use with a 110°, 26 in shadow mask colour picture tube A66-140X, in conjunction with convergence units AT 4045/. . or AT 4046/. . or AT 4050/. . , E.H.T. and semi-scan transformer AT 2100/04 combined with modulated semi-scan transformer AT 2101/02 or line-output transformer AT 2057/. . combined with a tripler, linearity control unit AT 4042/12 and blue lateral unit AT 1025/. . or AT 1068/. . .

Electrical data

Line deflection coils, series connected	
Inductance	4.4 mH
Resistance at 25°C	3.4 Ω
Deflection current at 25 kV, edge to edge scan in both directions	3.3 A p–p
Frame deflection coils, series connected	
Inductance	25.4 mH
Resistance	15 Ω + NTC (8 Ω)
Deflection current at 25 kV, edge to edge scan in both directions	1.2 A p–p
Maximum working temperature	95°C







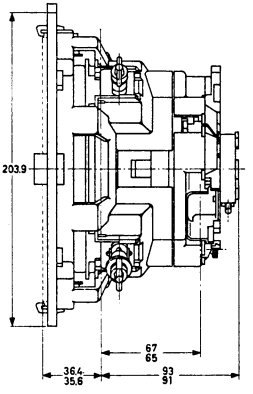
Deflection unit AT 1062/01 (with purity ring AT 1061)

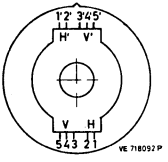
Catalogue number 3122 137 11720

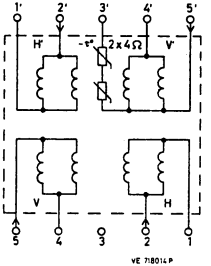
For use with a 110°, 26 in shadow mask colour picture tube A66-140X, in conjunction with convergence units AT 4045/. . or AT 4046/. . . , line-output transformer AT 2063/. . combined with a tripler, linearity control unit AT 4042/12 and blue lateral unit AT 1025/. . or AT 1068/. . .

Electrical data

Line deflection coils, series connected	
Inductance	1.2 mH
Resistance at 25°C	3.7 Ω
Deflection current at 25 kV, edge to edge scan in both directions	5.8 A p–p
Frame deflection coils, series connected	
Inductance	25 mH
Resistance at 25°C	15.5 Ω + NTC (8Ω)
Deflection current at 25 kV, edge to edge scan in both directions	1.12 A p–p
Maximum working temperature	95°C







COMPONENTS FOR COLOUR TELEVISION

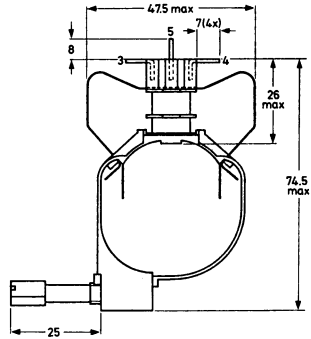
Blue lateral units **AT 1065/00,** catalogue number 3122 137 10280
AT 1065/01, catalogue number 3122 107 11850

For use with a 90° shadow mask colour picture tube in conjunction with a deflection unit AT 1027/.. or AT 1029/.., and convergence units AT 4045/.. or AT 4046/.. for static and dynamic lateral adjustment.

Static adjustment	AT 1065/00	AT 1065/01
Connection 1 and 3		
Inductance	200 mH	19.7 mH
Resistance	167 Ω	19.6 Ω
Dynamic adjustment		
Connection 4 and 2		
Inductance	0.76 mH	0.7 mH
Resistance	1.2 Ω	1.55 Ω

Maximum working temperature 95°C.

The unit must be positioned on the colour picture tube as close as possible to the convergence unit.

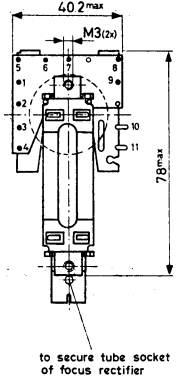


Line-deflection transformer AT 2051/00

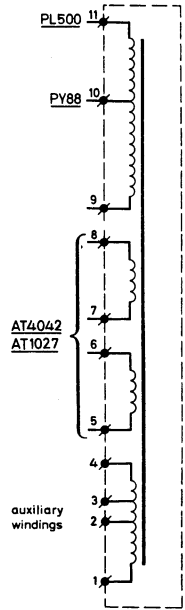
Catalogue number 3122 108 39390

This transformer has been designed to be used in combination with the E.H.T. transformer AT 2052/.. to drive a colour picture tube with a deflection angle of 90° and an E.H.T. of 25 kV.

It is intended for use in conjunction with deflection unit AT 1027/.. or AT 1029/.. linearity control AT 4042/.., transductor AT 4041/.., line-output tube PL500, focus voltage rectifier DY51 and booster diode PY88.



The transformer can be mounted on either a printed-wiring board (with a grid pitch of 2.54 or 2.50 mm) or a metal chassis.
Mounting height 66.5 mm



COMPONENTS FOR COLOUR TELEVISION

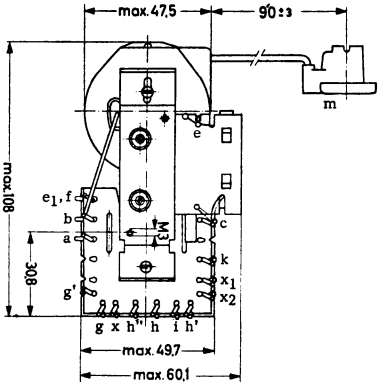
Line-output transformer AT 2053/02

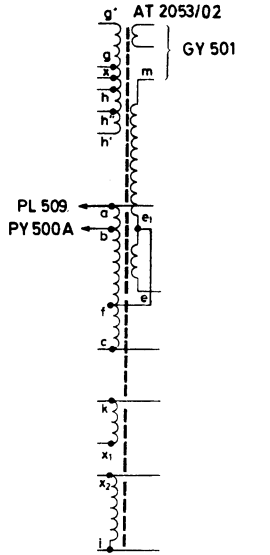
Catalogue number 3122 108 33920

For use with a 90° colour picture tube and deflection unit AT 1027/. . or AT 1029/. . , linearity control unit AT 4042/02, transductor AT 4041/. . , line output tube PL509, booster diode PY500A, rectifier tube GY501.

The transformer can be mounted either on a printed-wiring board (with a grid pitch of 2.54 or 2.50 mm) or on a metal chassis.

Mounting height max. 85.5 mm





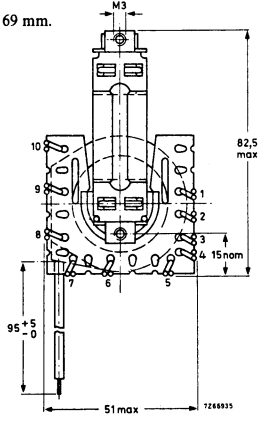
Line output transformer AT2063/00

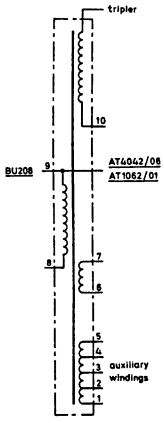
Catalogue number 3122 138 31010

This transformer has been designed to provide the required scanning amplitude for the 110° colour picture tube A66–140X in television receivers presenting 625 lines at 50 frames per second (CCIR) or 525 lines at 60 frames per second (USA).

It is intended for use in conjunction with:
- deflection unit AT1062/01
- linearity control unit AT4042/06
- line output transistor BU208
- E.H.T. tripler module BG1895-641.

The transformer can be mounted on either a printed-wiring board (with a grid pitch of 2,54 mm) or a metal chassis.
Mounting height 69 mm.





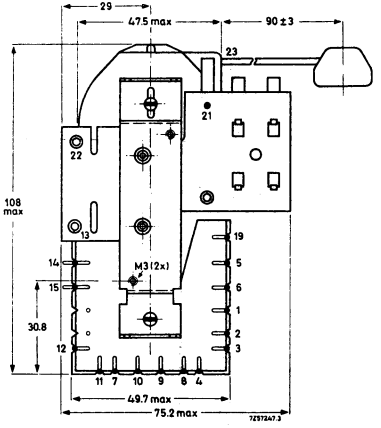
E.H.T. and semi-scan transformer AT 2100/04

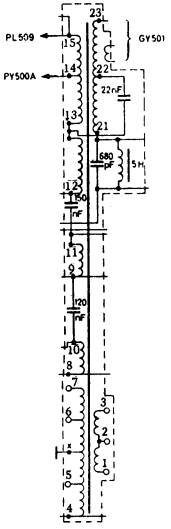
Catalogue number 3122 138 30020

For use with modulated semi-scan transformer AT 2101/02 and modulation balancing coil AT 4040/31, deflection unit AT 1060/. . . , line-output tube PL509, booster diode PY500A and rectifying tube GY501 to drive a 110° colour picture tube at an E.H.T. of 25 kV.

The transformer can be mounted either on a printed-wiring board (with a grid pitch of 2.54 or 2.50 mm) or on a metal chassis.

Mounting height max. 85.5 mm





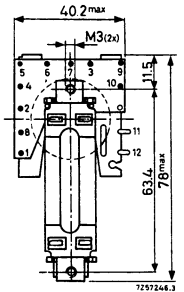
Modulated semi-scan transformer AT 2101/02

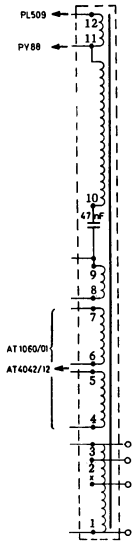
Catalogue number 3122 138 30380

For use with the E.H.T. and semi-scan transformer AT 2100/04 and the modulation balancing coil AT 4040/31 in conjuntion with deflection unit AT 1060/. . ., line output tube PL509 and booster diode PY88 to drive a 110° colour picture tube.

The unit can be mounted either on a printed-wiring board (with a grid pitch of 2.54 or 2.50 mm) or on a metal chassis.

Mounting height max. 66.5 mm





Convergence adjustors AT 4040/..

For use in conjunction with the convergence unit AT 4045/..., AT 4046/.. or AT 4050/.. for convergence adjustment.

type number	*circuit diagram*	*Fig.*	*terminals*	*L-range or L (mH)*	*d.c. resistance (Ω)*	*catalogue number*
AT 4040/35	A	1	1–5	0.17–0.07	0.48	3122 108 74390
			2–5	0.07–0.17	0.48	
			3–4	0.05	0.18	
AT 4040/44	B	2	3–4	15.6–3.0	11.5	3122 138 22870
AT 4040/49	C	1	3–4	1.06–0.33	2.4	3122 107 30030
			1–2	0.33–1.06	2.4	
AT 4040/53	B	2	3–4	3.72–0.63	3.65	3122 107 30060
AT 4040/57	C	1	3–4	0.32–0.10	0.66	3122 107 30090
			1–2	0.10–0.32		
AT 4040/56	E	1	4–5	0.024–0.006	0.11	3122 107 30080
			1–4	0.006–0.024	0.11	
			2–3	0.030–0.011	0.17	
AT 4040/58	C	1	3–4	8.15–2.5	20.7	3122 107 30100
			1–2	2.5–8.15		
AT 4040/61	B	2	3–4	33.5–7.2	23.1	3122 107 30130
AT 4040/63	C	1	3–4	0.44–0.11	1.35	3122 107 30480
				0.11–0.44	1.35	
AT 4040/89	C	1	1–2	4.5–12	25	3122 138 25770
			3–4	4.5–12	25	
AT 4040/92	D	1	3–4	0.07–0.22	0.65	3122 138 25780
			1–2	0.07–0.22	0.78	
			1–4	0.04	0.58	
AT 4040/93	C	1	1–2	0.21–0.58	1.05	3122 138 25790
			3–4	0.21–0.58	1.05	

The adjusters are provided with pins for mounting on printed-wiring boards and have a knob at the top for adjustment.

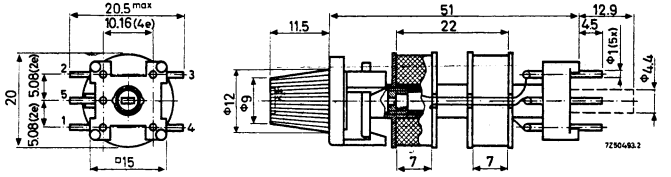


Fig. 1

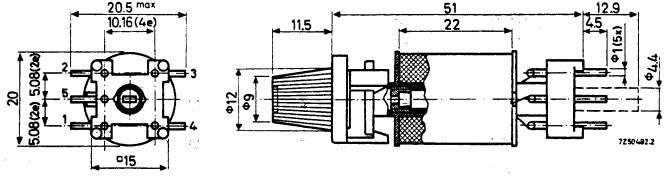
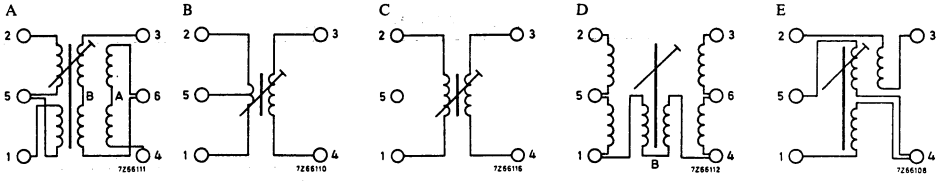


Fig. 2

Circuit diagrams



Correction coils AT 4040/..

The correction coils are mainly intended for use with the transductors AT 4041/.. and the deflection units AT 1027/.., AT 1029/.., AT 1060/.. and AT 1062.. for raster correction.

type number	*circuit diagram*	*Fig.*	*terminals*	*L-range or L (mH)*	*d.c. resistance (Ω)*	*catalogue number*
AT 4040/31 bridge coil	A	1	3–4	1.1	0.82	3122 108 74400
AT 4040/32 phase adjuster	B	2	3–4	1.6–4	1.18	3122 108 74340
AT 4040/34 2nd harm/anti-S	A	1	3–4	0.03–0.1	0.18	3122 108 74410
AT 4040/36 balancing coil	A	3	3–4	0.08–0.56	0.22	3122 138 21090
AT 4040/38	C	1	1–2	1.17	6.5	3122 138 26320
2nd harm			3–4	0.033–0.13	0.33	
AT 4040/50 amplitude adjuster	A	3	3–4	0.76–3.71	1.1	3122 107 31210
AT 4040/55 amplitude adjustor	A	3	3–4	246–11.5	4.1	3122 107 31220
AT 4040/85	D	4	1–2	0.03–0.1	0.23	3122 138 25750
balancing coil			3–4	0.03–0.1	0.23	
AT 4040/87 phase adjuster	E	2	3–4	$1.85 \pm 20\%$	2	3122 138 25760

The coils are provided with pins for mounting on printed-wiring boards. They can be adjusted at the top by means of a trimming key.

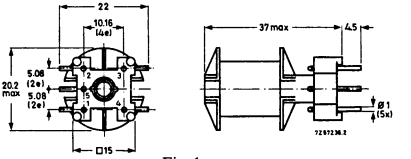


Fig. 1

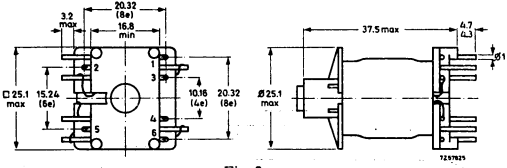


Fig. 2

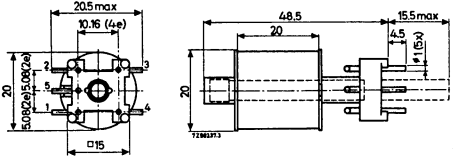


Fig. 3

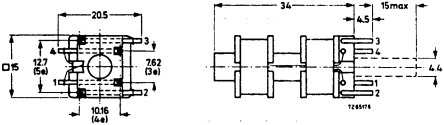
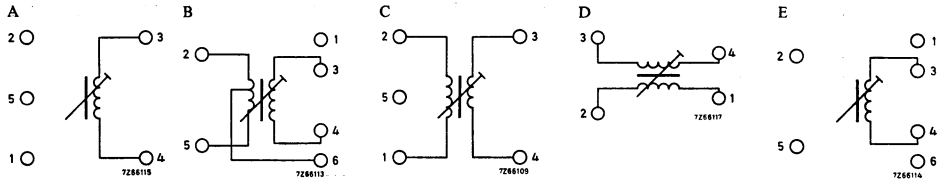


Fig. 4

Circuit diagrams

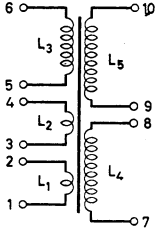


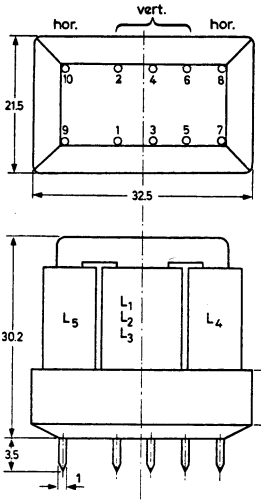
COMPONENTS FOR COLOUR TELEVISION

Transductor AT 4041/07

Catalogue number 3122 107 13410
For use in conjunction with the AT 1027/. . or AT 1029/. . , AT 2051/. . and AT 4040/. . and a frame-output transformer, to correct pin-cushion distortion.

The transductor can be mounted on a printed-wiring board with grid pitch of 2.54 mm.

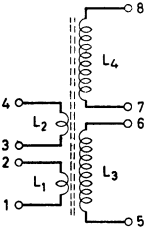


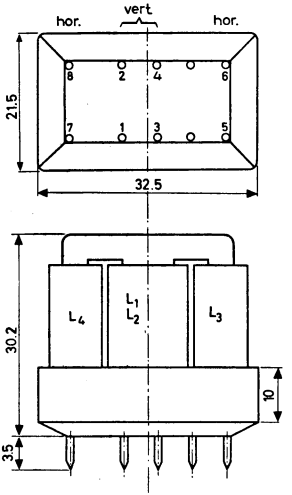


Transductor AT 4041/08

Catalogue number 3122 107 13420
For use in conjunction with the AT 1027/. ., AT 2051/. ., AT 4040/. . and the frame-output transformer, to correct pin-cushion distortion.

The transductor can be mounted on a printed-wiring board with grid pitch of 2.54 mm.





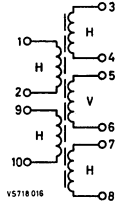
COMPONENTS FOR COLOUR TELEVISION

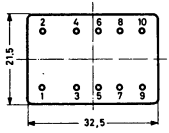
Transductor AT 4041/14

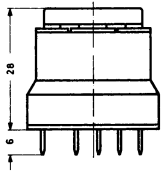
Catalogue number 3122 137 10530
For use in conjunction with the AT 1060/.. and in combination with AT 4041/15 for active E–W correction.

The transductor can be mounted on a printed-wiring board with grid pitch of 2.54 mm

H = Horizontal
V = Vertical





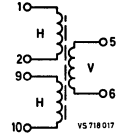


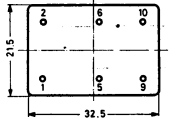
Transductor AT 4041/15

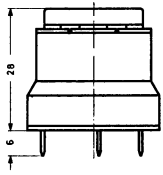
Catalogue number 3122 137 10540
For use in conjunction with the AT 2057/.. and in combination with AT 4041/14 for active E–W correction.

The transductor can be mounted on a printed-wiring board with a grid pitch of 2.54 mm

H = Horizontal
V = Vertical



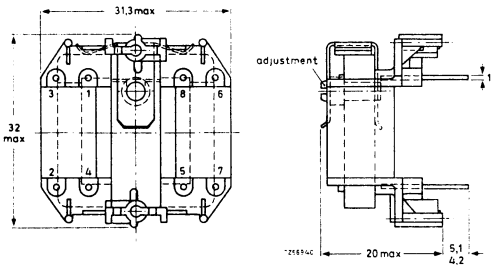




Transductor AT 4041/40

Catalogue number 3122 137 11660
For use in combination with deflection unit AT1062/01 and adjusters AT4040/87 and AT4040/38 for passive N/S rastercorrection in colour television tubes.

The transductor can be mounted on a printed-wiring board with a grid pitch of 2,54 mm.



COMPONENTS FOR COLOUR TELEVISION

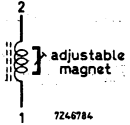
Adjustable linearity control unit AT 4042/02

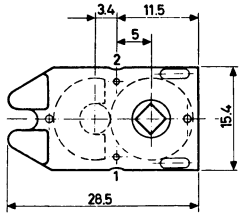
Catalog number 3122 108 39450

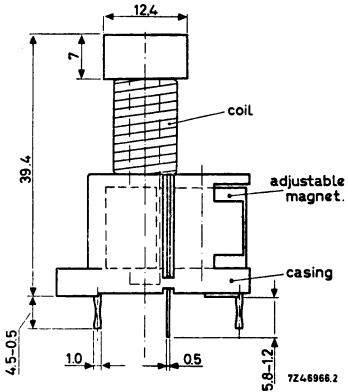
For use in colour TV sets equipped with tubes, to adjust the linearity of the line deflection. It can be used in combination with AT 1027/.. or AT 1029/..., and AT 2050/.. or AT 2051/.. or AT 2053/....

Electrical data

When a saw-tooth current (without S-correction) of 2.8 A_{p-p}, frequency 15,625 Hz, flyback ratio 18 %, flows through the linearity control unit (one connection point to earth), the correction voltage is adjustable between 15 V and 26 V





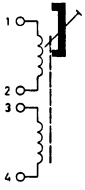


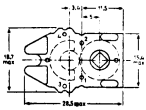
Adjustable linearity control unit AT 4042/12

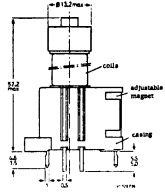
Catalogue number 3122 108 72720
For use in colour TV sets with a 110° deflection angle colour picture tube to adjust the linearity of deflection. It can be used in combination with AT 1060/. . or AT 1062/. . .

Electrical data
When a saw-tooth current (without S-correction) of 3.3 A p – p, frequency 15,625 Hz, flyback ratio 18%, flows through the linearity control unit (one connection point to earth), the correction voltage is 27 V.

The unit can be mounted either on a printed-wiring board with grid pitch of 2.54 mm or on a chassis.



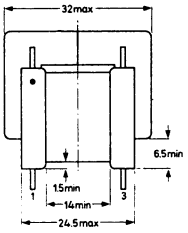


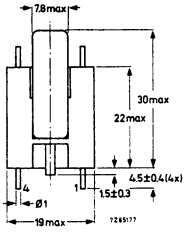


COMPONENTS FOR COLOUR TELEVISION

Bridge coil AT 4043/86

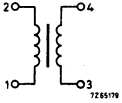
Catalogue number 3122 138 26050
For use in the single-transistor (BU208) line-output circuit for the 110° colour television tube A66-140X.
The unit can be mounted on a printed-wiring board with a grid pitch of 2.54 mm or 2.50 mm





Electrical data

Inductance	285 μH ± 10%
Resistance	< 0.2 Ω
Max. voltage, p – p	350 V
Max. current, p – p	6 A
Max. current, r.m.s.	1.75 A
Max. working temperature	55°C



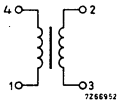
Line driver transformer AT 4043/87, Catalogue number 3122 138 26060

For use in the single-transistor (BU208) line-output circuit in conjunction with the 110° deflection coil AT1062/01.

The unit can be mounted on a printed-wiring board with a grid pitch of 2,54 mm.

Electrical data

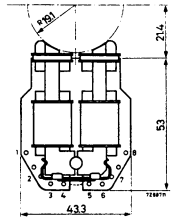
Inductance (primary)	76 mH ± 12%	For drawing
Leakage inductance (secondary)	< 2,5 μH	see AT 4043/86
Transformation ratio	29	
Max. working temperature	55°C	



Convergence unit AT 4045/07, catalog number 3122 108 83130
Convergence unit AT 4046/07, catalog number 3122 108 83150

This unit is intended to be used with a 90° or 110° shadow mask colour picture tube, in conjunction with the deflection unit AT 1027/.. or AT 1029/.. or AT 1060/.. or AT 1062/.. to converge the three colour pictures statically and dynamically and to adjust the purity.
The AT 4046/07 has a permanent magnet for static convergence

	Line coils		*Frame coils*			
	in series	*in parallel*	*in series*		*in parallel*	
			AT4045	AT4046	AT4045	AT4046
Connections	3 and 7	2 and 3	1 and 5	1 and 5	1 and 4	1 and 4
Interconnection	2–6	2–7	4–8	4–8	1–8	1–8
		3–6			4–5	4–5
Inductance	0.4	0.1 mH	1.35	1.44	0.34	0.36 H
Resistance	2	0.5 Ω	155	194	38.8	48.5 Ω

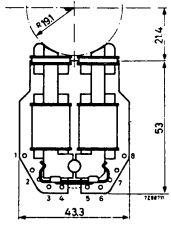


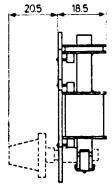
COMPONENTS FOR COLOUR TELEVISION

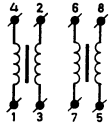
Convergence unit AT 4045/08, catalogue number 3122 108 83140
Convergence unit AT 4046/08, catalogue number 3122 108 83160

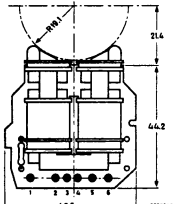
This unit is intended to be used with a 90° or 110° shadow mask colour picture tube, in conjunction with the deflection unit AT 1027/. . or AT 1029/. . or AT 1060/. . or AT 1062/. . to converge the three colour picture statically and dynamically and to adjust the purity.
The AT4046/07 has a permanent magnet for static convergence

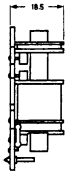
	Line coils		*Frame coils*			
	in series	*in parallel*	*in series*		*in parallel*	
			AT4045	AT4046	AT4045	AT4046
Connections	3 and 7	2 and 3	1 and 5	1 and 5	1 and 4	1 and 4
Interconnection	2–6	2–7	4–8	4–8	1–8	1–8
		3–6			4–5	4–5
Inductance	4.9	1.2 mH	1.35	1.52	0.34	0.38 H
Resistance	22.6	7 Ω	155	194	38.8	48.5 Ω







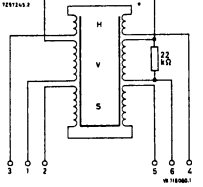




Convergence unit AT 4050/11

Catalogue number 3122 107 13220
This unit is intended to be used with a 110° shadow mask colour television picture tube, in conjunction with the deflection unit AT 1060/. . or AT 1062/. . to converge the three colour pictures statically and dynamically.

	Line coils	*Frame coils*	*Static coils*	*Series connected frame and static coils (2–6 inter-connected)*
Connections	3–4	1–6	2–5	1–5
Inductance	155	660	60 mH	1.2 H
Resistance	1	125	34 Ω	159 Ω



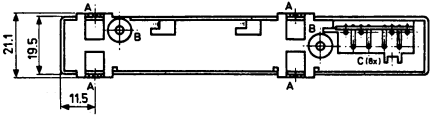
Delay line DL 20

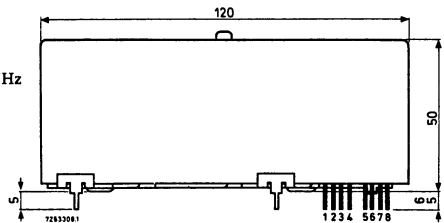
Catalog number: 2722 121 00061

For use in the decoder circuits of television receivers.

Electrical data

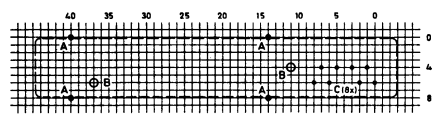
Nominal frequency f_{nom}	4.433619 MHz
Nominal phase delay-time (V_{in}-V_{out}) at f_{nom} (unmodulated sinewave voltage)	63.943 μs
Accurracy of adjustment	$\pm$5 ns at 25°C
Bandwidth (−3 dB points)	better than from 3.43 to 5.23 MHz
Insertion loss	11 $\pm$ 3 dB at f_{nom}
Temperature drift (relative to 25°C)	
phase delay	max. $\pm$5 ns between +20°C and +50°C
insertion loss	typical $\pm$ <0.3 dB
Maximum input at f_{nom}	10 V_{p-p}
Termination impedances	100 Ω





Connections: V_{in} to 4 and 3
V_{out} to 5 and 6

A = Fastening pins
B = Fixing holes (M3)
C = Connecting pins (0.8 mm diam.)



Hole pattern for mounting on a printed-wiring board. e = 2.54 mm.

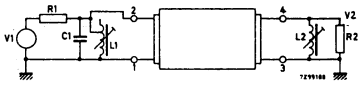
COMPONENTS FOR COLOUR TELEVISION

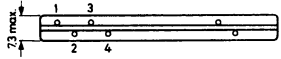
Delay lines DL 50, catalogue number 2722 121 00121
DL 51, catalogue number 2722 121 00131

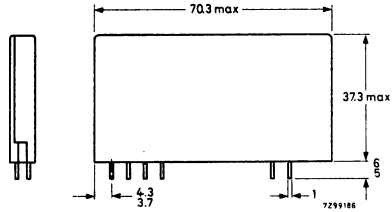
For use in decoder circuits of colour television receivers up to European PAL standard (DL50) and to European PAL/SECAM standard (DL51) respectively.

Electrical data

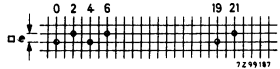
Nominal frequency f_{nom}	4.433619 MHz	
Phase delay-time ($V_{in} - V_{out}$) at f_{nom} (unmodulated sine-wave voltage)	63.943 ± 0.005 μs	
Bandwith (−3 dB points)	better than from 3.43 to 5.23 MHz	
Insertion loss at f_{nom}	8 ± 3 dB	
Drift of phase delay with temperature (relative to 25°C)	max. 5 ns	
Maximum input voltage at f_{nom}	15 V_{p-p}	
Termination-		
resistance	R_1, R_2	390 Ω
capacitance	C_1	120 pF
inductive reactance	L_1	128 Ω
	L_2	231 Ω
Maximum capacitance of the coils		20 pF







Connections: V_{in} to 2 and 1
V_{out} to 4 and 3



Recommended hole pattern for mounting on a printed-wiring board. e = 2.54 mm.

Delay line DL 53

Catalogue number 2722 121 00151

For use in decoder circuits of colour television receivers up to Brasilian PAL standard.

Electrical data

Nominal frequency f_{nom}	3.575611 MHz	
Phase delay time at f_{nom} (unmodulated sinewave voltage)	63.48 μs	
Bandwidth	< 2.7 to > 4.4 MHz	
Insertion loss	8 ± 3 dB	
Temperature drift of phase delay	max. 5 ns, typ 3 ns	
Maximum input voltage at f_{nom}	15 V_{p-p}	
Termination-		
resistance	R_1, R_2	560 Ω
capacitance	C_1	120 pF
inductive reactance	L_1	337 Ω
	L_2	405 Ω
Maximum capacitance of the coils		20 pF

For circuit diagram and mechanical data see DL50, DL51 page C288

Delay line DL 55

Catalogue number 2722 121 00171

For use in decoder circuits of colour television receivers up to NTSC standard.

Electrical data

Nominal frequency f_{nom}	3.579545 MHz	
Phase delay time at f_{nom} (unmodulated sinewave voltage)	63.55 μs	
Bandwidth	< 2.7 to > 4.4 MHz	
Insertion loss	8 ± 3 dB	
Temperature drift of phase delay	5 ns, typ 3 ns	
Maximum input voltage at f_{nom}	15 V_{p-p}	
Termination-		
resistance	R_1, R_2	560 Ω
capacitance	C_1	120 pF
inductive reactance	L_1	337 Ω
	L_2	405 Ω
Maximum capacitance of the coils		20 pF

For circuit diagram and mechanical data see DL50, DL51 page C288

MANGANESE ZINC AND NICKEL ZINC FERRITES

Introduction

The predominant feature of ferroxcube lies in its high resistivity that allows cores to be made of solid material without the eddy current losses becoming prohibitively high, even if the cores are used in the megacycle range. Compared with the powder-iron, the permeability of ferroxcube is high, whereas the losses remain comparatively low.

Ferroxcube cores are available in convenient shapes such as potcores, square cores*, E- and I-cores, X-cores, toroids, U-cores, aerial rods, yoke rings, screw cores, rods and tubes.

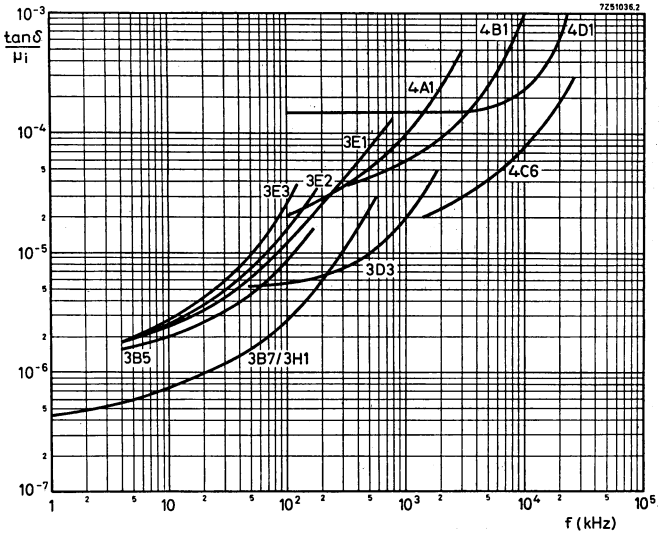
Potcores, E-I cores and X cores enable well-defined air gaps to be used without introducing appreciable stray fields. In this way the permeability of the material may be reduced to an effective value at which core and copper losses are matched. The dependence of the permeability on temperature and time is furthermore reduced to values that guarantee correct operation of the equipment.

This section contains comprehensive data on manganese zinc ferrites (ferroxcube 3) and nickel zinc ferrites (ferroxcube 4) and their various grades. The latter material in general shows higher specific resistance values, lower values of permeability and saturation flux density, higher coercivities and higher Curie points.

Application

grade	*application*
3B	potcores, cores for small coils
3B3	frames for i.f. transformers, potcores, rods, screw cores
3B5	potcores
3B7	potcores and square cores
3C1	erasing heads
3C2	yoke rings, L-cores, erasing heads
3C6	E- and U-cores
3C8	U-and I-cores, E-cores
3D3	potcores, square cores, screw cores
3E1	E- and I-cores, toroids, potcores
3E2	H-cores and toroids
3E3	toroids
3H1	potcores, square cores, small toroids, cross cores, erasing heads
4A3	aerial rods
4A4	frames for i.f. transformers
4B1	aerial rods, frames for i.f. transformers
4C1	rods and tubes
4C6	potcores, square cores, toroids, frames for i.f. transformers
4D1, 4D2, 4E1	frames for i.f. transformers, screw cores, tubes and rods
4H1 $4L_1$ $4L_2$ 4MX	These are special-purpose NiZn ferrites developed for one type of application, namely resonant cavities for particle accelerators. In this field, usually a technical discussion is necessary before the correct material can be determined.

*) Square cores actually are square potcores.



Eddy current losses and residual losses as a function of the frequency at low induction level

FERRITES FOR RADIO, AUDIO AND TELEVISION

Antenna rods and plates

Standard types

Rods

Grade 4A3

dimensions (mm)	*catalog number*
Ø 10 × 240	3122 104 93440
× 230	4311 020 53120
× 220	4311 020 52740
× 210	3122 104 93700
× 200	3122 104 93420
× 190	4311 020 53230
× 180	3122 104 93450
× 170	4311 020 52760
× 160	4311 020 52610
× 150	4311 020 52770
× 140	3122 104 93460
× 130	4311 020 52780
× 120	4311 020 53300
× 100	4311 020 52590
Ø 7.8 × 190	4311 020 52700
× 140	4311 020 52690
× 130	4311 020 52680
× 100	4311 020 52790
Ø 6.35 × 130	4311 020 52800
× 100	4311 020 52810

Grade 4B1

dimensions (mm)	*catalog number*
Ø10 × 204	3122 104 91250
× 175	4311 020 52240
× 140	3122 104 91240
× 130	4311 020 52230
Ø9.8 × 200	4311 020 50040
× 160	4311 020 50250
× 100	4311 020 52170
Ø6.5 × 165	4311 020 52160

Plates

Grade 4B1	*dimensions (mm)*	*catalog number*
	19 × 3.8 × 150	4311 020 52410
	× 125	4311 020 52400
	× 100	4311 020 52390
	× 75	4311 020 52380
	13.4 × 4.15 × 120	3122 104 92140
	× 94	3122 104 92120
	× 62	3122 104 92150

Cores for small coils, e.g. i.f. transformers

Preferred types

To be used as cores in r.f. and h.f. coils with an open magnetic circuit such as in i.f. transformers.

Rods

dia. (mm)	*length (mm)*	*grade*	*catalogue number*
1.4	6.75	3D3	3122 104 91920
		4C5	3122 104 92040
		4D1	3122 104 91910
1.5	6.75	3D3	4322 020 39390
1.5	18.2	3B	3122 104 93320
1.65	9.2	3D3	4312 020 30160
		4B1	3122 104 91060
		3B1	3122 104 91070
	11.5	3B1	4322 020 32100
	12.2	3B1	3122 104 91100
		4B1	3122 104 91110
		3D3	4312 020 30170
	19.2	3B	3122 104 91230
	25.2	3B	3122 104 91170
		4B1	3122 104 91180
		4C1	3122 104 91160
	28.2	4B1	4322 020 32090
		3B	3122 104 91090

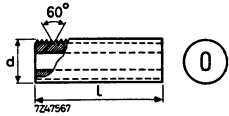
dia. (mm)	*length (mm)*	*grade*	*catalog number*
1.7	7.5	4E1	4322 020 39300
	8.4	4D1	3122 104 93160
		3B	3122 104 90300
	10.2	4D1	4322 020 32040
	14.2	4E1	4322 020 32060
	15.2	4D1	4322 020 32170
	17.8	3B	3122 104 92020
	18.7	3B	3122 104 91900
	28.2	4C1	4322 020 32120
		4D1	4322 020 32130
		4E1	4322 020 32140
1.75	10.2	3B	3122 104 91130
	12.2	4B1	3122 104 92070
	12.7	3B	3122 104 91970
	17.5	3B	3122 104 91210
		4B1	4322 020 32050
	18.5	3B	3122 104 91140
		4B1	3122 104 91150
	18.7	3B	3122 104 91260
	25	3B	3122 104 91950
2.3	10.5	3D3	4312 020 30030
	12.5	3D3	4312 020 30180
	18.5	3D3	4312 020 30200
3.45	17.3	3C6	4312 020 30420
3.5	23.2	3C3	3122 104 92080
4.3	21.2	3C1	3122 104 91330
4.5	7.2	3D3	4322 020 39350
4.95	36	3C6	3122 104 90490
	16	3C6	4322 020 39340
	45	3C6	3122 134 90190
	50	3C6	3122 134 90110
5.55	40.1	3V6	4322 020 32240
6	46.2	3C1	3122 104 91310
6.6	35.15	3C6	4322 020 39330
6.65	40.4	3B	4322 020 32160

Tubes

outer dia. (mm)	*inner dia. (mm)*	*length (mm)*	*grade*	*catalogue number*
2.8	1.2+0.2	8.2	3B	4322 020 34340
3.6	1.3+0.2	4.2	3D3	4322 020 38340
			4C6	4322 020 38350
3.7	1.2+0.2	3.5	3B	4322 020 34400
			4A1	4322 020 34410
			4B1	4322 020 34420
		6.5	3B	4022 101 80010
3.7	1.7+0.2	13.7	4E1	4322 020 34330
4	1.8+0.4	23.2	3B	3122 104 90880
4.1	2+0.2	4.7	4C6	4322 020 38310
		7	3H1	4322 020 38330
4.15	2+0.2	7.2	4A1	4322 020 34440
		12.2	4A1	3122 104 90820
			4B1	4322 020 34450
			4C1	4322 020 34460
			4D1	4322 020 34470
			4E1	4322 020 36990
		15.2	4B1	4322 020 34380
			4C1	4322 020 34370
			4D1	4322 020 34360
4.3	2+0.2	7.2	3B	3122 104 92900
		11.5	3B	3122 104 94880
		15.4	3B	4322 020 36750
		16.5	3B	3122 104 94920
		18.5	3B	4322 020 36770
		21.2	4B1	3122 134 90160
		25.5	3B	4322 020 36780
			4B1	3122 104 90810
			4C1	3522 200 10950
			4D1	3522 200 10960
			4E1	3522 200 10970
		36.2	3B	3522 100 65950
		40.5	3B	3122 104 90800
		55.5	3B	4322 020 36800
		7.2	4D1	3122 104 93890
4.95	1.3+0.2	15.2	3C3	3122 104 90370
		23.2	3C3	3122 104 90380
	2.9+0.2	36	3C6	3122 104 93760
	1.3+0.2	36.2	3C3	3122 104 94030
		40.5	3C3	3122 104 93110
5.1	1.8+0.2	4.8	4D2	3122 104 94990
5.4	3.3+0.3	25.3	4A1	3122 104 93720
6.7	2.85+0.3	33.5	3B	4322 020 34300

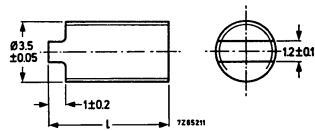
Screw cores

FXC grade 3D3
$\mu_i = 750 \pm 20\%$



screw thread	*l* (*mm*)	*d* (*mm*)	*catalog number*
M4 x 0.50	12	3.65 + 0.05	4312 020 32040
M5 x 0.75	12	4.55 + 0.05	4312 020 32050
M6 x 0.75	25	5.55 + 0.05	4312 020 32070
M6 x 0.75	13	5.55 + 0.05	4312 020 32060
M8 x 1.25	25	7.35 + 0.05	4312 020 32120
M8 x 1.25	16	7.35 ± 0.05	4312 020 32110

[1]) Grade 3B



Special cores for I.F. coils

	grade	*l* (*mm*)	*pitch*	*catalogue number*
3.5 x 0.7	3B	10 ± 0.2	0.7	3122 104 90550
	4D1	10 ± 0.2	0.7	90590
	4B1	10 ± 0.2	0.7	93020
	4D1	7 ± 0.2	0.7	90740

Beads for screening and damping, and wide-band h.f. chokes

APPLICATION

They are used in v.h.f. radio and TV receivers and in electric motors, ignition systems etc. to reduce in- or outgoing interference, and also in v.h.f. circuits to avoid troublesome coupling.

Beads (without wire)

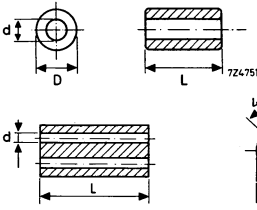


Fig. 1

Fig. 3

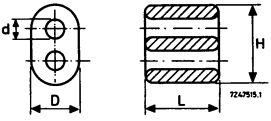
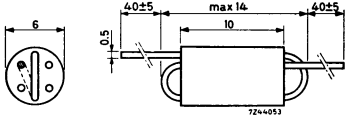


Fig. 2

Fig.	*grade*	*L* (*mm*)	*D* (*mm*)	*H* (*mm*)	*d* (*mm*)	*catalog number*
1	3B	3	3.5	—	1.3 ± 0.2	4322 020 34400
1	4B1	3	3.5	—	1.3 ± 0.2	4322 020 34420
1	3B	5	3.5	—	1.3 ± 0.2	4312 020 31060
2	4B1	8	8.5	14	$3.5 + 0.5$	4312 020 31570
2	4B1	14	8.5	14	$3.5 + 0.5$	4312 020 31520
3	3B	10	6	—	$0.7 + 0.2$	4312 020 31500
3	4B1	10	6	—	$0.7 + 0.2$	4312 020 31550

H.F. chokes

Dimensions in mm



number of turns	Z_{opt} (kΩ)	*f at* Z_{opt} (*MHz*)	*decrease of impedance in the freq. range* (*MHz*)	*dB*	*FXC grade*	*catalog number*
1.5	0.25	120	10–300	$\leqslant 7$	3B	4312 020 36630
1.5	0.35	250	80–300	$\leqslant 3$	4B1	4312 020 36690
2.5	0.60	50	10–220, 30–100	$\leqslant 7$, $\leqslant 3$	3B	4312 020 36640
2.5	0.65	180	50–300, 80–220	$\leqslant 6$, $\leqslant 3$	4B1	4312 020 36700
2×1.5	0.70	50	10–220, 30–100	$\leqslant 7$, $\leqslant 3$	3B	4312 020 36650
2×1.5	0.80	110	50–300, 80–220	$\leqslant 7$, $\leqslant 3$	4B1	4312 020 36710

Cores for erasing heads

Material: ferroxcube 3H1

catalogue number *number*	*Fig.* *no.*	*L* (*mm*)	*B* (*mm*)	*p* (*mm*)	*b* (*mm*)	*H* (*mm*)	*D* (*mm*)	*d* (*mm*)
3104 101 80400	1	11	3.5	1.5	—	1.9	2.2	4.7
3103 209 12030	2	10.9	3.25	—	2.1	1.7	—	—
3103 209 12040	5	10.9	4.4	2.5	—	1.7	1.7	—
3103 224 90090	4	9	2.6	—	1.8	2.4	—	—
3103 224 90100	3	9	3.5	1.8	2.6	2.4	1.7	—

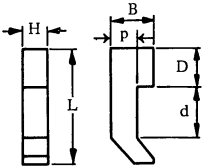


Fig. 1

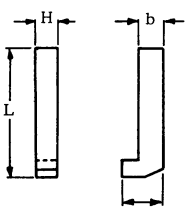


Fig. 2

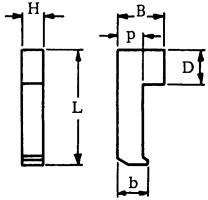


Fig. 3

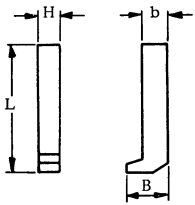


Fig. 4

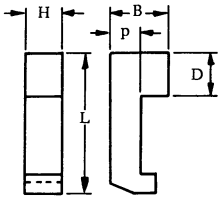
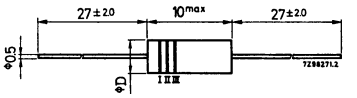


Fig. 5

MICROCHOKES

Dimensions (in mm)



inductance	*D*
0.1–1000 μH	4 mm
1.5– 100 mH	6.5 mm

The colour code indicates the nominal value of the inductance in μH.

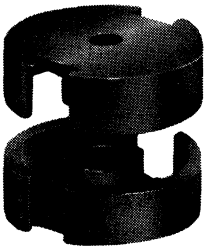
colour	*band I first digit*	*band II second digit*	*band III multiplier*
silver			10^{-2}
gold			10^{-1}
black	0	0	1
brown	1	1	10^{1}
red	2	2	10^{2}
orange	3	3	10^{3}
yellow	4	4	10^{4}
green	5	5	10^{5}
blue	6	6	10^{6}
violet	7	7	
grey	8	8	
white	9	9	

nominal inductance (μH)	*quality factor*		*max. d.c. resistance* (Ω)	*max.* C_0 (pF)	*catalogue number*
	Q	*at freq.* (MHz)			
0.10	45	25	0.10	1	2422 535 00107
0.15	45	25	0.12	1	2422 535 00157
0.22	45	25	0.14	1	2422 535 00227
0.33	45	25	0.17	1	2422 535 00337
0.47	45	25	0.21	1	2422 535 00477
0.68	45	25	0.25	1	2422 535 00687
1.0	45	25	0.31	1	2422 535 00108
1.5	40	8	0.38	1	2422 535 00158
2.2	40	8	0.45	1	2422 535 00228
3.3	40	8	0.53	1	2422 535 00338
4.7	40	8	0.63	1	2422 535 00478
6.8	40	8	1.00	1	2422 535 00688
10	40	8	1.70	1	2422 535 00109
15	40	2	0.55	1	2422 535 00159
22	40	2	0.70	1	2422 535 00229
33	40	2	0.90	1	2422 535 00339
47	40	2	1.35	1	2422 535 00479
68	40	2	1.6	1	2422 535 00689
100	40	2	1.9	1	2422 535 00101
150	45	0.8	3.5	1	2422 535 00151
220	45	0.8	6.5	1	2422 535 00221
330	45	0.8	11	1	2422 535 00331
470	50	0.8	20	1	2422 535 00471
680	50	0.8	41	1	2422 535 00681
1000	50	0.8	48	1	2422 535 00102
1500	50	0.25	25	4	2422 535 01152
2200	50	0.25	30	4	2422 535 01222
3300	45	0.25	50	4.5	2422 535 01332
4700	45	0.25	60	5	2422 535 01472
6800	40	0.25	75	4.5	2422 535 01682
10000	40	0.1	90	4	2422 535 01103
15000	40	0.1	110	3.5	2422 535 01153
22000	40	0.1	130	3	2422 535 01223
33000	35	0.1	275	3	2422 535 01333
47000	35	0.1	400	3.5	2422 535 01473
68000	30	0.1	470	3.5	2422 535 01683
100000	25	0.1	720	3.5	2422 535 01104

PRE-ADJUSTED FERROXCUBE POTCORES, P-SERIES

Introduction

Ferroxcube potcores have been developed for stable low loss filters, coils and transformers. Due to their closed shape they combine a low weight with a small volume.
The principal properties of a potcore with a given inductance value are the quality factor Q, the temperature coefficient T.F., the disaccommodation factor D.F. and, if the potcore is used on higher induction values, the generation of third harmonics.



application	*approximate frequency range*	*ferroxcube grade*
filter coils	from 0.1 to 200 kHz	3B7, 3H1
	200 kHz to 2 MHz	3D3
	2 MHz to 20 MHz	4C6
loading coils, transformers chokes	up to 60 kHz	3H1
	200 Hz to 10 MHz	3H1

Cores

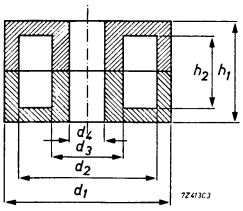
Dimensions

The main dimensions of the potcores are in conformity with the following standardisation specifications:

IEC publication 133
CCTU 06–04 and 06–08 (France)
DIN 41 293 (Germany) and B.S. 4061 (Gr. Britain)

TABLE 1

basic type number	*nominal dimensions (mm)*					
	d_1	d_2	d_3	d_4	h_1	h_2
P9/5	9.3	7.6	3.8	2.05	5.3	3.45
P11/7	11.1	9.20	4.60	2.05	6.50	4.55
P14/8	14.0	11.8	5.90	3.10	8.40	5.80
P18/11	17.9	15.1	7.45	3.10	10.6	7.40
P22/13	21.5	18.2	9.25	4.50	13.4	9.40
P26/16	25.5	21.6	11.3	5.50	16.0	11.2
P30/19	30.0	25.4	13.3	5.50	18.9	13.2
P36/22	35.5	30.4	15.8	5.50	21.9	14.8
P42/29	42.4	36.3	17.4	5.50	29.4	20.5



Available types

Below is given a selection of the most current types (provided with nut for adjuster) of our potcore program. For other types and more data see our Data Handbook.

TABLE 2

potcore	A_L-*factor*	*material grade*	*catalogue number*	*relevant adjuster catalogue number*
P9/5	25	4C6	4322 022 61810	—
	100	3B7	61040	4322 021 31270
	100	3H1	61240	31270
P11/7	40	3D3	4322 022 21420	4322 021 31250
	40	4C6	21820	—
	160	3B7	21050	31540
	160	3H1	21250	31540
P14/8	63	3D3	4322 022 23430	4322 021 30740
	63	4C6	23830	30940
	160	3B7	23050	30950
	160	3H1	23250	30950
	250	3B7	23060	31070
	250	3H1	23260	31070
P18/11	63	4C6	4322 022 25830	—
	100	3D3	25440	4322 021 30770
	250	3B7	25060	30970
	250	3H1	25260	30970
	315	3B7	25070	30730
	315	3H1	25270	30730
P22/13	100	4C6	4322 022 27840	—
	160	3D3	27450	4322 021 31000
	315	3B7	27070	31020
	315	3H1	27270	31020
	400	3B7	27080	31100
	400	3H1	27280	31100
P26/16	100	4C6	4322 022 29840	4322 021 30790
	250	3D3	29460	30980
	400	3B7	29080	30810
	400	3H1	29280	30810
	630	3B7	29100	30810
	630	3H1	29300	30810
P30/19	250	3D3	4322 022 31460	4322 021 30980
	630	3B7	31100	30810
	630	3H1	31300	30810
	1000	3B7	31110	31090
	1000	3H1	31310	31090

PRE-ADJUSTED POTCORES

potcore	A_L-*factor*	*material grade*	*catalogue number*	*relevant adjuster catalogue number*
P36/22	250	3D3	4322 022 33460	4322 021 30880
	630	3B7	33100	30810
	630	3H1	33300	30810
	1000	3B7	33110	31090
	1000	3H1	33310	31090
P42/29	630	3B7	4322 022 35100	30810
	630	3H1	35300	30810
	1000	3B7	35110	31090
	1000	3H1	35310	31090

Coil formers

The dimensions of the coil formers are in conformity with the following standardisation specifications:

IEC publication 133
CCTU 06-02 (France)
DIN 41 294 (Germany)

TABLE 3

pot core type	*catalogue number* 1 *section*	2 *sections*	3 *sections*
P9/5	4322 021 31700	—	—
P11/7	4322 021 30240	—	—
P14/8	4322 021 30250 30070[1])	4322 021 30260	—
P18/11	4322 021 30270 30090[1])	4322 021 30280	4322 021 30290
P22/13	4322 021 30300 30110[1])	4322 021 30310	4322 021 30320
P26/16	4322 021 30330 30130[1])	4322 021 30340	4322 021 30350
P30/19	4322 021 30360	4322 021 30370	4322 021 30380
P36/22	4322 021 30390	4322 021 30400	4322 021 30410
P42/29	4322 021 30420	4322 021 30430	—

[1]) Versions with soldering pins to fit 0,1 inch and 2,50 mm grid.

Inductance adjusters

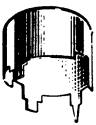
The inductance of a pre-adjusted potcore can be increased by inserting an adjuster. For each type of potcore the corresponding type of adjuster, which will increase the published A_L value by a minimum of 9% and a maximum of 14% approximately is given in Table 2. For potcores P26/16, P30/19, P36/22 and P42/29 a series of step-by-step adjuster is available. These adjusters are used when a continuous adjustment of the inductance is not necessary. For instance, they are applied in loading coils to bring the inductance within a certain tolerance.
A range of 13 flexible conical step-by-step adjusters is available under the catalog numbers 4322 021 32000 up to 4322 021 32120. The higher this number the greater the effect. An adhesive is used as sliding and fixing material.

The values of A_L mentioned in Table 2 are to be used for the potcores without the adjusting mechanism.

Mounting

Coil former

adjuster with nut


container

spring

tag plate

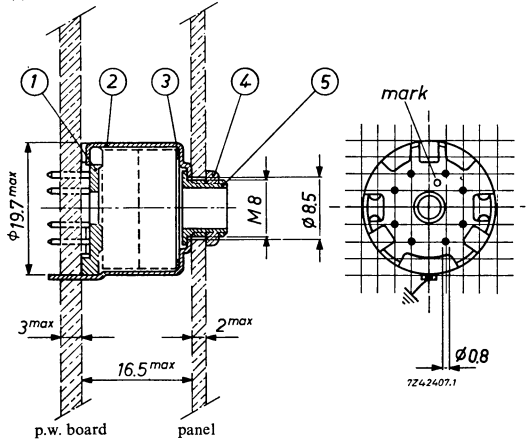
fixing bush with nut

Potcored coils can be mounted on conventional panels, as well as on printed-wiring boards, the location of the soldering tags being matched to the 0.1 in as well as to the 2.50 mm grid. The insulating material of the tag plate can fully withstand the temperatures occurring during dip-soldering.
After placing the spring in the container, the core is brought under the correct pressure by pressing the tag plate down to the rim of the container. It will be held in place after the three ears have been folded over. For conventional panel mounting, a fixing bush and nut are separately available. Types P9/5, P11/7 and P14/8 do not possess this mounting facility.
Further information on the design of simple tools for potcore assembly will be gladly supplied on request.
For several potcore types coil formers are available provided with p.w. pins, which make the use of mounting parts superfluously.

PRE-ADJUSTED POTCORES

Mounting on P.W. board or on panel

(1) tag plate
(2) brass container } see Table 4
(3) spring
(4) nut 4322 021 30710
(5) fixing bush 4322 021 30720



The parts (1), (2) and (3) are sufficient to construct an assembly for use in combination with printed-wiring.

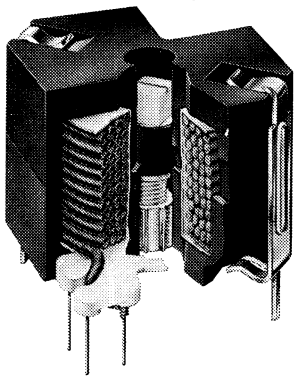
TABLE 4

potcore type	*catalogue number* (1) *tag plate*	(2) *brass container*	(3) *spring*
P9/5	—	—	—
P11/7	4322 021 30180	4322 021 30510	4322 021 30620
P14/8	30440	30520	30630
P18/11	30450	30530	30640
P22/13	30460	30540	30650
P26/16	30470	30550	30660
P30/19	30480	30560	30670
P36/22	30490	30570	30680
P42/29	30500	30580	30690

PRE-ADJUSTED FERROXCUBE SQUARE CORES

Introduction

Ferroxcube squarecores have been developed for stable low loss filters, coils and transformers. Due to their closed shape they combine a low weight with a small volume.
The principal properties of a square core with a given inductance value are the quality factor Q, the temperature coefficient T.F., the disaccommodation factor D.F. and, if the potcore is used on higher induction values, the generation of third harmonics.



application	*approximate frequency range*	*ferroxcube grade*
filter coils	from 0.1 to 200 kHz	3B7, 3H1
	200 kHz to 2 MHz	3D3
	2 MHz to 20 MHz	4C6
loading coils, transformers chokes	up to 60 kHz	3H1
	200 Hz to 10 MHz	3H1

Cores

Dimensions
The main dimensions of the square cores are in conformity with the following standardisation specifications:

IEC publication 133
CCTU 06–04 and 06–08 (France)
DIN 41 293 (Germany) and B.S. 4061 (Gr. Britain)

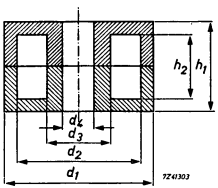


TABLE 1

basic type number	*nominal dimensions (mm)*					
	d_1 *max*	d_2 *min*	d_3 *max*	d_4 *min*	h_1 *max*	h_2 *min*
RM4	9.8	8.0	3.9	2.0	10.5	7.0
RM5	12.3	10.2	4.9	2.0	10.5	6.3
RM6R	14.7	12.4	6.4	3.0	12.5	8.0
RM6S	14.7	12.4	6.4	3.0	12.5	8.0
RM8	19.7	17.0	8.9	4.4	16.5	10.8

PRE-ADJUSTED SQUARE CORES

Available types

Below a selection of the most current types (provided with nut for adjuster) of our square core program is given. For other types and more data see our Data Handbook.

TABLE 2

potcore	A_L-*factor*	*material grade*	*catalogue number*	*relevant adjuster, catalogue number*
RM4	25	4C6	4322 022 77810	—
	40	3D3	77420	4322 021 31250
	100	3B7	77040	31270
	100	3H1	77240	31270
	1940	3E1	57700[1])	—
	2790	3E4	57900[1])	—
RM5	40	4C6	4322 022 79820	4322 021 31250
	63	3D3	79430	31260
	160	3B7	79050	31540
	160	3H1	79250	31540
	3450	3E1	59900[1])	—
	4975	3E4	59990[1])	—
RM6-R	63	4C6	4322 022 75830	4322 021 30760
	100	3D3	75440	30770
	315	3B7	75070	30730
	315	3H1	75270	30730
	4780	3E1	55800[1])	—
	6710	3E4	55900[1])	—
RM6-S	63	4C6	4322 022 67830	—
	100	3D3	67440	—
	315	3B7	67070	4322 021 30730
	315	3H1	67270	30730
	4400	3E1	47800[1])	—
	5500	3E4	47900[1])	—
RM8	63	4C6	4322 022 71830	—
	100	3D3	71440	—
	400	3B7	71080	4322 021 31100
	400	3H1	71280	31100
	6300	3E1	51800[1])	—
	8000	3E4	51900[1])	—

[1]) Without nut and centre hole.

Coil formers

The dimensions of the coil formers are in conformity with the following standardisation specifications:

IEC publication 133
CCTU 06-02 (France)
DIN 41 294 (Germany)

TABLE 3

square core type	*coil former catalogue number* 4322 021.....						*retaining clip*
	single section			*two sections*			
	4 pins	*6 pins*	*8 pins*	*12 pins*	*4 pins*	*6 pins*	
RM4	—	31800	—	—	—	—	4322 021 31900
RM5	—	31860	—	—	—	—	4322 021 31900
RM6-R	31720	31710	—	—	31740	31730	4322 021 31780
RM8	31870	—	31880	31890	—	—	4322 021 31840
	catalogue number 4312 021						
RM6-S	29240	29250	—	—	—	—	4322 021 31780

Inductance adjusters

The inductance of a pre-adjusted core can be increased by inserting an adjuster. For each type of core the corresponding type of adjuster, which will increase the published A_L value by a minimum of 9% and a maximum of 14% approximately is given in Table 2.
The values of A_L mentioned in the tables are to be used for the cores without the adjusting mechanism.

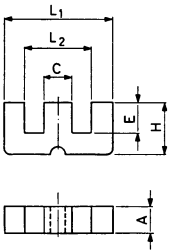
Mounting

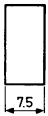
The core halves are clamped together by means of two clips (see Table 3). As can be seen in the photograph, the hooked ends of either clip fall into recesses made in the core halves.
The two retaining clips are also used for mounting the assembled core on a printed-wiring board: the gold plated pins are simply soldered into the holes in the board. If so desired, one of the pins can also be used for earthing the core.
The soldering pins of coil formers and clips are so arranged that they will fit printed-wiring boards with a 0.1 in grid as well as those with a 2,50 mm grid.
The figure in the basic type number indicates the board area required, e.g. RMS needs a square of 0,5 inch side.

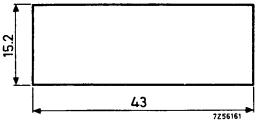
TRANSFORMER CORES

E- and I-cores

These cores are typical transformer cores. They can be used from voice frequencies up to some MHz.







type	*dimensions*						*ferroxcube*	*air gap*	*catalog number*
	L_1	L_2	*C*	*A*	*H*	*E*	*grade*	*(mm)*	
E13/7/3	12.95	9.43	3.3	3.3	6.7	4.95	3H7	0	4322 020 34510
E20/10/5	20.7	12.8	5.2	5.3	10	6.3	3E1	0	4322 020 34530
								0.15	34550
							improved 3E1	0	34830
E30/15/7	30.8	19.5	7.2	7.3	15	9.7	3E1	0	4322 020 34630
								0.15	34650
								0.30	34660
							improved 3E1	0	34840
E42/21/15	43	29.5	12.2	15.2	21	14.8	3E1	0	4322 020 34720
								0.25	34740
								0.5	34750
							improved 3E1	0	34850
I42/7.5/15	see figure above						3E1	0	4322 020 37320
E55/28/21	56.2	37.5	17.2	21	27.5	18.5	3E1	0	4322 020 34780
E65/32/13	66.5	44.2	20	13.7	32.5	22.2	3E1	0	4322 020 34820

The dimensions are according to D.I.N. 41295

With two E-cores or one E-core and one I-core a shell type transformer can be composed.

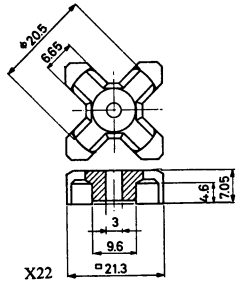
shell type transformer	*composed of*	A_e (cm^2)	$\Sigma \frac{l_e}{A_e}$ (cm^{-1})	V_e (cm^3)	μ_e	A_L (nH)	*cat. number of coil former* *without pins* 4312 021	*with pins* 4322 021 .....
13/13/3	2 × E13/7/3	0.101	30.9	0.318	⩾1390	⩾566		
20/20/5	2 × E20/10/5	0.312	13.7	1.34	1650–2760	1515–2520	28431	20240
30/30/7	2 × E30/15/7	0.597	11.2	4.00	1795–2990	2010–3350	28550	20250
42/42/15	2 × E42/21/15	1.82	5.34	17.6	1910–3140	4425–7380	28622	21830
42/29/15	1 × E42/21/15 + 1 × I42/7.5/15	1.83	3.67	12.3	>1820	>6300		
55/55/21	2 × E55/28/21	3.54	3.48	43.7	1950–3250	7050–11700	28711	
65/65/27	4 × E65/32/13	5.32	2.75	78.2	1835–3050	8400–14000	28721	

TRANSFORMER CORES

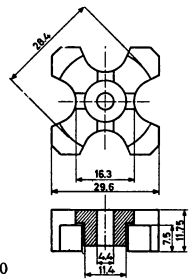
Cross cores

These cores have been developed for transformers to be used on printed-wiring boards. The soldering pins are positioned according to a grid of 2.52 mm.

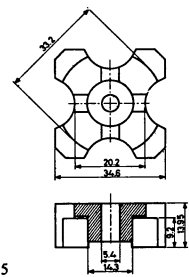
core half	*ferroxcube grade*	*air gap (mm)*	*catalog number*
X22	3E1	0	3522 200 03470
		0.15	4322 020 23700
	improved 3E1	0	4322 020 23530
	3H1	0	4322 020 23510
		0.02	4322 020 23710
		0.05	4322 020 23720
		0.15	4322 020 23730
		0.25	4322 020 23740
	3B7	0	3522 200 08770
	3D3	0	3522 200 03480
	4C6	0	3522 200 03490
X30	improved 3E1	0	4322 020 23760
	3H1	0	4322 020 23750
		0.02	4322 020 23960
		0.05	4322 020 23970
		0.15	4322 020 23980
		0.25	4322 020 23990
X35	3H1	0	4322 020 24000
		0.02	4322 020 24210
		0.05	4322 020 24220
		0.15	4322 020 24230
		0.25	4322 020 24240



X22

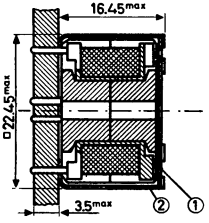


X30

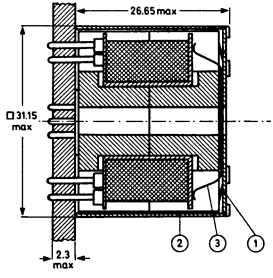


X35

Cross-core	*ferroxcube grade*	A_e (cm^2)	$\Sigma \frac{l_e}{A_e}$ (cm^{-1})	V_e (cm^3)	μ_e	*catalog number of coil former*
X22	3E1 improved	0.66	5.75	2.51	≥ 1495 2000–	4322 021 31770
	3E1	0.66	5.75	2.51	3325	
	3H1	0.66	5.75	2.51	≥ 1440	
	3B7	0.66	5.75	2.51	≥ 1440	
	3D3	0.66	5.75	2.51		
	4C6	0.66	5.75	2.51		
X30	improved 3E1	1.14	4.90	6.36	2200– 3675	4322 021 31190
	3H1	1.14	4.90	6.36	≥ 1525	
X35	3H1	1.64	4.10	11.0	≥ 1580	4322 021 31200 (16 pins) 4322 021 30190 (8 pins)

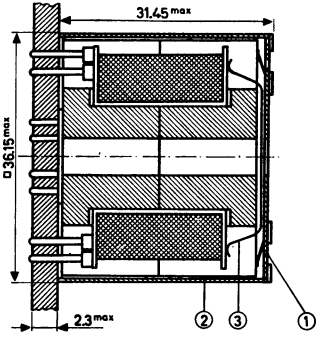


Core assembly X22
(1) Cover 4322 021 30230
(2) Container 4322 021 30040



Core assembly X35
(1) Cover 4322 021 31160
(2) Container 4322 021 31180
(3) Spring 4322 021 30220

Core assembly X30
(1) Cover 4322 021 31150
(2) Container 4322 021 31170
(3) Spring 4322 021 30210



TRANSFORMER CORES

Pre-adjusted cross cores X22
Cross cores with standard A_L factors

A_L	*corresponding* μ_e*-value*	*tolerance on inductance* (%)	*catalog number* 4322 022 6. . . ., *with nut* 4322 022 4. . . ., *without nut*
			ferroxcube grade 3H1
160	73	±1	5250
250	115	±1.5	5260
400	180	±2	5280
630	290	±3	5300

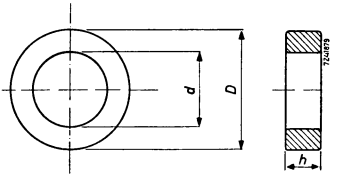
Inductance $L = N^2 A_L$ (in 10^{-9} H)

Inductance adjusters

A_L *of core in* 3H1	*recommended adjuster*	
	catalog number	*colour*
160	4322 021 30970	white
250	4322 021 30970	white
	4322 021 30730	brown
400	4322 021 30730	brown
	4322 021 31080	grey
630	4322 021 31080	grey
1000	4322 021 31080	grey

Toroids

Toroids are mainly used in broadband transformers, pulse transformers and chokes.



dimensions (mm) $D \times d \times h$	*ferroxcube grade*	l_e *(cm)*	$\sum \frac{l_e}{A_e}$ (cm^{-1})	V_e (cm^3)	μ_{tor}	*catalog number*
2 × 1.3 × 0.7	3E3	0.511	208	0.00125	> 10 000	8222 293 03230
3.93 × 2.23 × 1.27	3E3		87.4		10000–15000	4322 020 90780
	3B7					4322 020 90820
4 × 2.2 × 1.1	3E2	0.946	95.6	0.00937	> 5000	4322 020 36650
	3E3				> 10000	4322 020 36700
	3H1				[1]	4322 020 36590
4.83 × 2.28 × 1.27	3E3		66.3		10000–15000	4322 020 90790
	3B7					4322 020 90830
5.84 × 3.05 × 1.52	3E3		63.4		10000–15000	4322 020 90800
	3B7					4322 020 90840
6 × 4 × 2	3E2	1.55	77.5	0.0310	> 5000	4322 020 36660
	3E3			–	> 10000	4322 020 36710
	3H1				[1]	4322 020 36600
	4C6				> 100	4322 020 36500
9 × 6 × 3	3E2	2.33	51.7	0.105	> 5000	4322 020 36670
	3E3				> 10000	4322 020 36720
	3H1				[1]	4322 020 36610
	4C6				> 100	4322 020 91010

dimensions (mm) $D \times d \times h$	*ferroxcube grade*	l_e *(cm)*	$\sum \frac{l_e}{A_e}$ (cm^{-1})	V_e (cm^3)	μ_{tor}	*catalog number*
9.53 × 4.75 × 3.18	3E3		28.4		10000–15000	4322 020 90810
	3B7					4322 020 90850
14 × 9 × 5	3E2	3.55	28.5	0.445	> 5000	4322 020 36680
	3H1				[1])	4322 020 36620
	4C6				> 100	4322 020 91020
23 × 14 × 7	3E2	5.70	18.1	1.79	>5000	4322 020 36690
	3H1				[1])	4322 020 36630
	4C6				> 100	4322 020 91070
29 × 19 × 7.5	3E1	7.50	20.1	2.58	2700 ± 20%	4322 020 36550
36 × 23 × 10	3E1	9.20	14.2	5.60	2700 ± 20%	4322 020 36560
36 × 23 × 15	3E1	9.20	9.42	8.50	2700 ± 20%	4322 020 36570
	4C6				> 100	4322 020 91090

[1]) μ_{tor} is indicated by the colour of the circumference of the core. see table below,

group	μ_{tor}	*colour*
2	2140–2360	red
3	2300–2540	orange
4	2480–2740	yellow
5	2680–2960	green
6	2900–3210	blue
7	3150–3480	violet
8	3420–3780	grey
9	3720–4110	white

The sorting into μ groups is done merely for the convenience of the user. The toroids are not available per separate group.

PERMANENT MAGNET MATERIALS

Introduction

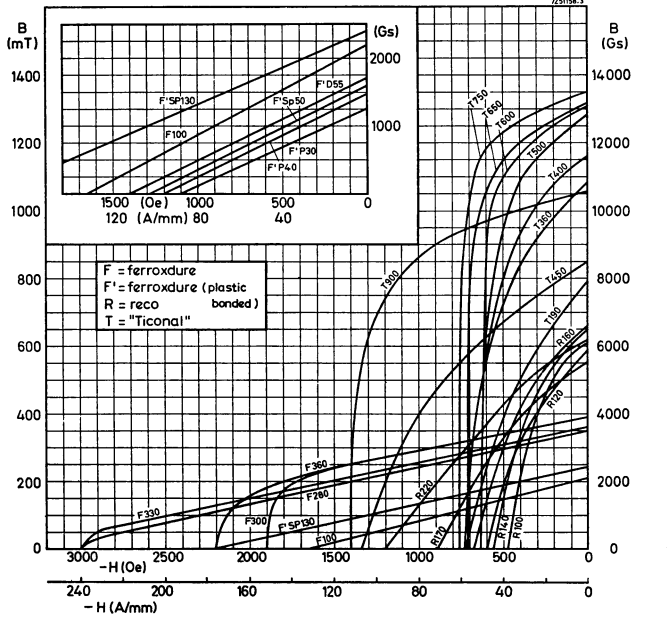
Permanent magnets – either isotropic* or anisotropic* – can be classified as being basically either
metallic alloy
ceramic material or
plastic bonded ceramic material
The table shows the class to which each of our materials belongs.

	metallic alloy	*ceramic material*	*plastic bonded ceramic material*
isotropic*	reco	ferroxdure	ferroxdure
anisotropic*	"Ticonal"**	ferroxdure	ferroxdure

The most obvious differences between the groups are that the ferroxdure magnets are characterised by high values of coercivity and resistivity while "Ticonal" magnets possess higher values of remanent magnetism and energy product.
Ferroxdure is therefore most suitable for applications in which demagnetising influences (either from external sources or resulting from the use of short magnets) are large and also in high frequency applications.
"Ticonal" is particularly suitable for applications in which high values of magnetic energy are required from small volumes of magnetic material.
The isotropic materials in general are inferior in magnetic properties to the anisotropic ones but are particularly suitable for applications in which multipolar magnets are to be used or where less expensive magnets are necessary giving a reasonable performance.
The plastic bonded ferroxdure magnets combine the characteristic magnetic properties of isotropic ferroxdure (however on a lower level) with the mechanical properties of the plastic material used. These magnets open a new field of applications, especially where the price is of prime importance.
Each of the permanent magnet materials is manufactured in a variety of grades possessing different properties that result from differences in composition and treatment.
The grades are distinguished by the addition of letters and numbers to the name of the material. The numbers are approximately relative to the nominal energy product of the grade.

* Isotropic materials can be magnetised equally well in any direction. Anisotropic materials have optimal magnetic properties in one direction only.
** "Ticonal" is a registered trade name.

Demagnetisation curves



Conversion table for S.I. units (Giorgi units)

1000 Gs $= 100$ mT $(= 0.1$ Wb/m$^2)$

1 Oe $= \dfrac{10^3}{4\pi}$ A/m ≈ 0.08 A/mm

1 MGs · Oe $= 8$ kJ/m^3

1 Mx $= 0.01\ \mu$Wb

$\mu_0 = 4\pi \cdot 10^{-7}$ H/m $= 1$ Gs/Oe

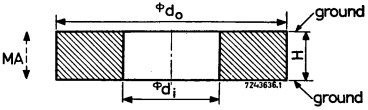
PREFERRED TYPES

A "selection" of our preferred types is given below. A complete list of preferred types, comprising the shapes and sizes of permanent magnets from existing moulds and dies, is available on request. We offer every assistance in the primary and secondary aspects of permanent magnets and their systems.

Anisotropic ferroxdure

Ring magnets for loudspeakers etc.

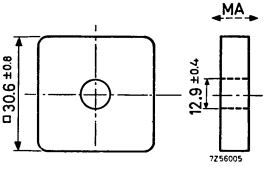
Material: Fxd 300R
Magnetic axis: axial
Supplied unmagnetised



dimensions						*catalog number*
outer diam.		*inner diam.*		*H*		
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	
36	±0.8	18	±0.5	8	±0.1	4322 020 60070
45	±1	22	±0.6	9	±0.1	60110
51	±1.2	24	±0.6	9	±0.1	60150
53	±1.2	24	±0.5	11	±0.1	4304 071 80620
55	±1.2	24	±0.6	12	±0.1	4322 020 60170
60	±1.5	24	±0.6	13	±0.1	60200
72	±1.5	32	±0.7	15	±0.1	60240
90	±1.8	36	±0.9	17	±0.15	60280
102	±3	51	±1.5	10	±0.15	60300
121	±3.6	57	±1.7	12	±0.2	60320
134	±4	57	±1.7	14	±0.2	60330
184	±5.5	73	±2.2	18.5	±0.2	60350

Square magnet for loudspeakers

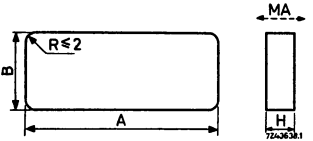
Material: Fxd 300R
Magnetic axis: axial
Supplied: unmagnetised
Catalog number: 4322 020 63010



PERMANENT MAGNET MATERIALS

Blocks

Material: see below
Magnetic axis: ⊥ A × B
Supplied: magnetised

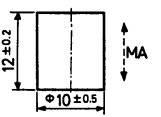


dimensions						*material*	*catalog number*
A		*B*		*H*			
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*		
15	±0.3	9	±0.5	5	±0.25	280K	3122 104 92700
50	±1.3	19	±0.5	4.9	−0.25	280K	62100[1])
50	±1.3	19	±0.5	6.1	±0.1	280K	62120[1])
131	±3	51	±1.5	17.5	±0.2	330K	62140[1])

[1]) Supplied unmagnetised.

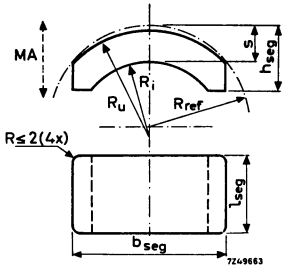
Solid cylinders

Material: Fxd 280
Magnetic axis: axial
Supplied: magnetised
Catalog number: 4322 020 61010



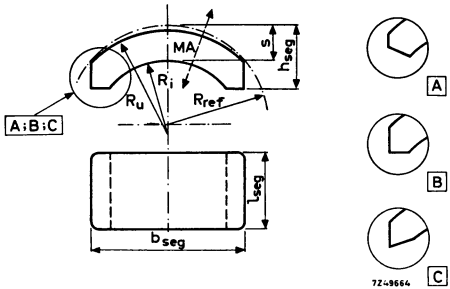
Segments for d.c. motors

Material: Fxd 330
Magnetic axis: diametrical
Supplied: unmagnetised



R_i	R_u	s	h_{seg}		b_{seg}		l_{seg}		*catalog number*
mm	*tol.*	*mm*	*mm*	*tol.*	*mm*	*tol.*	*mm*	*tol.*	
⩾8.315	⩾12.025	⩽3.66	8	±0.6	18	±0.5	15	±1	4322 020 61850
⩾20.3	⩾29	⩽8.8	16	±0.3	42	±1	41	±1	4311 021 30660

Material: Fxd 280
Magnetic axis: radial
Supplied: unmagnetised



R_i	R_u	s	h_{seg}		b_{seg}		l_{seg}		*catalog number*	*Fig.*
mm	*mm*	*mm*	*mm*	*tol.*	*mm*	*tol.*	*mm*	*tol.*		
⩾28.58	⩾35.13	⩽6.55	25.5	±0.6	62.4	+0.4	26.7	±0.75	4322 020 61510	A
⩾28.50	⩾35.55	⩽7.35	21.4	−1.2	60.3	+3.0	49.4	±1	61820	C
⩾29.03	⩾36.02	⩽7.49	21.79	±0.38	62.7	+3.0	27.88	±1.25	61590	B

PERMANENT MAGNET MATERIALS

Isotropic ferroxdure

Discs and bars

Material: Fxd 100
a) axially magnetised

Fig. 1

dimensions				*catalog number*	*Fig.*
diam. d		*H*			
mm	*tolerance*	*mm*	*tolerance*		
3	±0.2	7.5	±0.25	4312 020 60130	1
6	±0.3	40	±0.6	60170	1
4	±0.2	3.5	±0.2	65950	2
25	±0.5	5	±0.4	65870	2

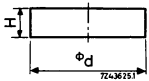
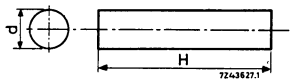


Fig. 2

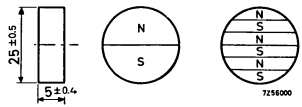
b) diametrically magnetised rods



dimensions				*catalog number*
diam. d		*H*		
mm	*tolerance*	*mm*	*tolerance*	
4	±0.1	10	±0.2	4312 020 60040
6	−0.05	12	±0.2	3122 104 94330

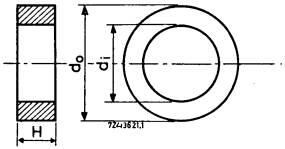
c) laterally magnetised disc

6 poles on 1 face
Catalog number 4312 020 65780



Rings

Material: Fxd 100



a) diametrically magnetised

dimensions						*catalog number*
outer diam.		*square hole*		*H*		
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	
12.25	±0.25	3.2	±0.5	10	±0.5	4312 020 62110
12	+0.5	3.2	±0.5	12	±0.5	62120

b) axially magnetised

dimensions						*catalog number*
outer diam.		*inner diam.*		*H*		
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	
14	±0.5	1.5	±0.5	5	±0.5	4312 020 62180
29.9	−0.05	10	±0.3	5	−0.1	62270[1])

[1]) 4p axially magnetised.

c) radially magnetised

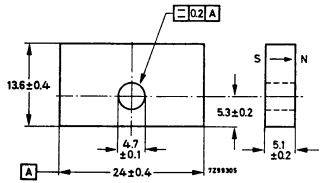
dimensions						*magnetisation*	*catalog number*
outer diam.		*inner diam.*		*H*			
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*		
12	±0.5	4.05	±0.3	7	±0.5	S pole on circ.	4312 020 63150
27	±0.7	20	±0.6	3.5	±0.5	N pole on circ.	62340

d) rings for couplings (laterally magnetised)

dimensions						*magnetisation*	*catalog number*
outer diam.		*inner diam.*		*H*			
mm	*tol.*	*mm*	*tol.*	*mm*	*tol.*		
55	±0.05	15	±0.5	13	±0.1	12 poles on outer ∅	4312 020 62430
78	±1.5	58	±0.05	13	±0.1	12 poles on inner ∅	62420

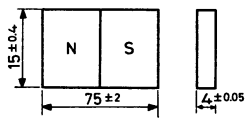
Block with holes

Material: Fxd 100
magnetised ⊥ A × B
Catalog number 4312 020 66710



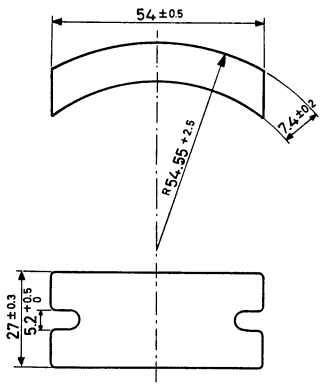
Block

Material: Fxd 100
laterally magnetised
8 poles on 75 × 15
Catalog number 4312 020 66860



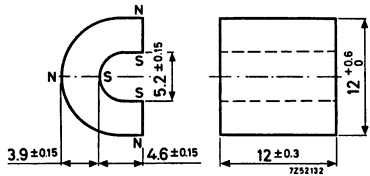
Segment

Material: Fxd 100
not magnetised
Catalog number 4312 020 61500



Special parts for colour TV sets

Material: see below
Supplied: magnetised



article	*dimensions in mm*		*material*	*magnetic axis*	*catalog number*
	diameter d	*H*			
Disc	20±0.35	5±0.3	Fxd100	diametric	3122 104 90620
Bar	5–0.2	10±0.2	Fxd100	diametric	92850
Segment	see drawing		P40	radial	93770

Isotropic plastic-bonded ferroxdure

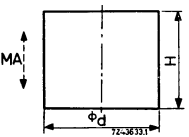
Material: see below Supplied: magnetised

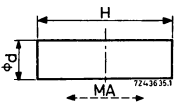
article	*dimensions*	*material*	*magnetic axis*	*catalog number*
Strip	(9±0.3) × (3±0.1)	P40	2 poles lateral	4312 020 70020
Ring	∅(28±0.1) × (20.5±0.1) × (16.5±0.25)	D55	2 poles on int. circ.	4312 020 72040
Block	(10.6–0.6) × (10.6–0.6) × (3±0.15)	P30	diametrical	3122 104 93540
Bar	∅(5±0.2) × (40–1)	P40	axial	3122 104 90360
Rings with 1 to 3 lobes for T.V. deflection units		SP10 or P40	2 poles on int. circ.	

Anisotropic "Ticonal"

Solid cylinders

Material: see below
Direction of magnetisation: axial
Supplied: unmagnetised



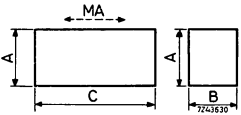


dimensions				*material*	*catalog number*
d		*H*			
mm	*tolerance*	*mm*	*tolerance*		
12.9	−0.3	10	−0.05	'Ticonal' 750	4322 059 75060
15.8	−0.1	13	±0.1	'Ticonal' 750	75030
18	−0.4	12	−0.1	'Ticonal' 600	60000
19.4	±0.3	9.4	±0.1	'Ticonal' 750	75080
21	±0.5	16	±0.05	'Ticonal' 600	60010
28.3	±0.4	19.45	±0.05	'Ticonal' 600	61060
34.7	±0.4	19	±0.05	'Ticonal' 600	61080

Cylindrical slugs in "Ticonal" 750 can be supplied in any length. Standard diameters are between 12 and 22 mm; others available if required

Blocks

Material: see below
Direction of magnetization: ⊥ face A × B
Version: see below



dimensions						*material*	*version*	*catalog number*
A		*B*		*C*				
mm	*tol.*	*mm*	*tol.*	*mm*	*tol.*			
2	±0.05	2.6	±0.05	2.25	−0.03	'Ticonal' 900	unmagnetised	4322 059 90000
4	±0.05	4	±0.05	5	±0.02	'Ticonal' 900	unmagnetised	90010
27	−1	20	±0.5	17	±0.05	'Ticonal' 450	unmagnetised	45130
100	±1	12	±0.05	29.1	±0.05	'Ticonal' 500	unmagnetised	50130[1])
10.5	±0.2	17	±0.3	40	±0.05	'Ticonal' 500	unmagnetised	50170

[1]) with two mounting holes.

TYPE NUMBER INDEX OF TUBES, SEMICONDUCTORS, INTEGRATED CIRCUITS, COMPONENTS AND MATERIALS

A28-14W	A62	AC125	B54	AD5780/..	C190
A31-20W	A62	AC126	B54	AD6980/..	C191
A31-120W	A62	AC127	B54	AD7061/..	C192
A31-410W	A62	AC127/01	B54	AD7065/..	C191
A44-120W	A63	AC128	B55	AD7080/..	C188
A47-14W	A63	AC128/01	B55	AD7091/..	C188
A47-26W	A63	AC132	B55	AD8060/..	C191
A50-120W	A63	AC132/01	B55	AD8065/..	C192
A56-120X	A64	AC172	B55	AD8080/..	C189
A56-140X	A64	AC187	B56	AD12100/..	C193
A59-11W	A63	AC187/01	B56	AEY29	B18
A59-15W	A63	AC188	B56	AEY29R	B18
A59-16W	A63	AC188/01	B56	AEY31	B18
A59-23W	A63	AD0160/..	C191	AEY31A	B18
A61-120W	A63	AD149	B90	AF121	B72
A63-11X	A64	AD161	B90	AF124	B72
A63-120X	A64	AD162	B90	AF125	B72
A65-11W	A63	AD1056/..	C192	AF126	B72
A66-120X	A64	AD1065/..	C192	AF127	B73
A66-140X	A64	AD1256/..	C192	AF139	B73
AA119	B2	AD1265/..	C192	AF239	B73
AAY21	B2	AD2070/..	C187	AF239S	B73
AAY30	B2	AD2071/..	C191	AF240	B74
AAY32	B2	AD3070/..	C187	AF267	B74
AAY39	B17	AD3370/..	C187	AFY16	B74
AAY39A	B17	AD3590/..	C189	AGR9950	A150
AAY51	B17	AD3880/..	C189	AP2151/..	C184
AAY51R	B17	AD3890/..	C189	AP2152/..	C184
AAY52	B17	AD4070/..	C187	AP2153/..	C185
AAY52R	B17	AD4080/..	C187	AP2154/..	C185
AAY59	B18	AD4090/..	C188	AP2155/..	C186
AAZ13	B2	AD4680/..	C190	AP2156/..	C186
AAZ15	B3	AD4690/..	C190	APY16	
AAZ17	B3	AD5060/..	C191	to	
AAZ18	B3	AD5080/..	C188	APY19	A187

APY21		AT1060/01	C206	AW59-91	A65
to		AT1062/01	C207	AW61-88	A66
APY27	A187	AT1065/00	C208	AZ41	A2
APY30	A187	AT1065/01	C208	B310..series	A149
APY31	A187	AT2036/10	C200	B312..series	A149
APY36		AT2036/37	C201	B318..series	A149
to		AT2051/00	C209	B330..series	A149
APY38	A187	AT2053/02	C210	B410..series	A149
APY41 to		AT2063/00	C211	B419..series	A149
APY49	A187	AT2100/04	C212	BA100	B3
APY56		AT2101/02	C213	BA102	B14
to		AT4040/..	C214	BA114	B3
APY59	A187	AT4041/07	C218	BA145	B34
ASY26	B116	AT4041/08	C219	BA148	B34
ASY27	B116	AT4041/14	C220	BA182	B14
ASY28	B116	AT4041/15	C220	BA216	B3
ASY29	B117	AT4041/40	C221	BA217	B4
ASY73	B117	AT4042/02	C222	BA218	B4
ASY74	B117	AT4042/12	C223	BA219	B4
ASY75	B117	AT4043/86	C224	BA220	B4
ASY76	B118	AT4043/87	C224	BA221	B4
ASY77	B118	AT4045/07	C225	BA222	B5
ASY80	B118	AT4045/08	C226	BA314	B5
ASZ15	B91	AT4046/07	C225	BA315	B5
ASZ16	B91	AT4046/08	C226	BA316	B5
ASZ17	B91	AT4050/11	C226	BA317	B5
ASZ18	B91	AT7130	C202	BA318	B5
ASZ21	B118	AT7130/01	C202	BAV10	B5
AT1025/05	C203	AVHC41	A145	BAV18	B6
AT1025/08	C203	AVHC201	A145	BAV19	B6
AT1027/07	C204	AW43-88	A64	BAV20	B6
AT1027/09	C205	AW47-91	A65	BAV21	B6
AT1029/07	C205	AW53-80Z	A65	BAV40	B7
AT1029/09	C205	AW53-88	A65	BAV41	B7
AT1040	C199	AW59-90	A65	BAV42	B7

BAV43	B9	BC109	B57	BCW46	B65
BAV45	B9	BC146	B58	BCW47	B65
BAV46	B19	BC147	B58	BCW48	B65
BAV70	B146	BC148	B58	BCW49	B65
BAW56	B146	BC149	B58	BCW56	B65
BAW62	B9	BC157	B58	BCW57	B66
BAW95D	B19	BC158	B59	BCW58	B66
BAW95E	B19	BC159	B59	BCW59	B66
BAW95F	B19	BC177	B59	BCW69	B148
BAW95G	B19	BC178	B59	BCW70	B148
BAX12	B9	BC179	B60	BCW71	B148
BAX13	B10	BC200	B60	BCW72	B148
BAX14	B10	BC237	B61	BCY10	B66
BAX15	B10	BC238	B61	BCY11	B66
		BC239	B61	BCY12	B67
BAX16	B10	BC307	B61	BCY30	B67
BAX17	B10	BC308	B62	BCY31	B67
BAX18	B11	BC309	B62	BCY32	B67
BAY66	B14	BC327	B62	BCY33	B67
BAY96	B19	BC328	B63	BCY34	B68
BB60	C17	BC337	B63	BCY38	B68
BB104B	B14	BC338	B63	BCY39	B68
BB104G	B15	BC547	B63	BCY40	B68
12-BB105A	B15	BC548	B63	BCY54	B68
12-BB105B	B15	BC549	B64	BCY55	B153
12-BB105G	B15	BC557	B64	BCY56	B69
3-BB106	B15	BC558	B64	BCY57	B69
4-BB106	B15	BC559	B64	BCY58	B69
BB110B	B15	BCA1	C3	BCY59	B69
BB110G	B16	BCA10	C8	BCY70	B70
BB113	B16	BCW29	B147	BCY71	B70
BB17	B16	BCW30	B147	BCY72	B70
BBY31	B146	BCW31	B147	BCY87	B153
BC107	B57	BCW32	B147	BCY88	B153
BC108	B57	BCW33	B147	BCY89	B154

BCZ10	B70	BD434	B99	BF198	B79
BCZ11	B71	BD435	B99	BF199	B79
BCZ12	B71	BD436	B99	BF200	B79
BD115	B92	BD437	B99	BF245A	B138
BD124	B92	BD438	B100	BF245B	B138
BD131	B92	BDY20	B100	BF245C	B138
BD132	B93	BDY38	B100	BF254	B79
BD133	B93	BDY60	B101	BF255	B80
BD135	B93	BDY61	B101	BF257	B80
BD136	B93	BDY90	B101	BF258	B80
BD137	B94	BDY91	B101	BF259	B80
BD138	B94	BDY92	B101	BF334	B80
BD139	B94	BDY93	B101	BF335	B81
BD140	B94	BDY94	B102	BF336	B81
BD181	B95	BDY95	B102	BF337	B81
BD182	B95	BDY96	B102	BF338	B81
BD183	B95	BDY97	B102	BF494	B81
BD201	B96	BDY98	B102	BF495	B82
BD202	B96	BDY99	B102	BFR29	B138
BD203	B96	BF115	B75	BFR30	B149
BD204	B96	BF167	B75	BFR31	B149
BD226	B96	BF173	B75	BFR53	B149
BD227	B97	BF177	B75	BFR63	B82
BD228	B97	BF178	B76	BFR64	B82
BD229	B97	BF179	B76	BFR65	B82
BD230	B97	BF180	B76	BFR90	B83
BD231	B97	BF181	B76	BFR91	B83
BD232	B98	BF182	B77	BFR92	B150
BD233	B98	BF183	B77	BFR93	B150
BD234	B98	BF184	B77	BFS17	B151
BD235	B98	BF185	B77	BFS18	B151
BD236	B98	BF194	B77	BFS19	B151
BD237	B98	BF195	B78	BFS20	B151
BD238	B99	BF196	B78	BFS21	B139
BD433	B99	BF197	B78	BFS21A	B139

BFS22A	B104	BLX91	B107	BPY68	A136
BFS23A	B104	BLX92	B107	BPY69	A136
BFS28	B140	BLX93	B107	BPY75-300	A187
BFS92	B83	BLX94	B107	BPY76	A136
BFS93	B83	BLY14	B108	BPY77	A136
BFS94	B84	BLY17	B108	BPY81	
BFS95	B84	BLY83	B108	to	
BFW10	B140	BLY84	B108	BPY87	A187
BFW11	B140	BLY87A	B109	BPY88	A187
BFW12	B140	BLY88A	B109	BPY89	A187
BFW13	B141	BLY89A	B109	BR100	B41
BFW16A	B84	BLY90	B109	BR101	B154
BFW17A	B84	BLY91A	B110	BRY39	B41
BFW30	B85	BLY92A	B110	BRY39(SCS)	B155
BFW45	B113	BLY93A	B110	BRY39(PUT)	B155
BFW61	B141	BLY94	B110	BSS27	B119
BFW92	B85	BPX10		BSS28	B120
BFW93	B85	to		BSS29	B120
BFX34	B119	BPX14	A187	BSS40	B120
BFX44	B85	BPX25	A135	BSV15	B121
BFX89	B86	BPX29	A135	BSV16	B121
BFY44	B104	BPX40	A135	BSV17	B121
BFY50	B86	BPX41	A135	BSV52	B152
BFY51	B86	BPX42	A135	BSV64	B121
BFY52	B86	BPX56	A187	BSV68	B121
BFY55	B87	BPX57	A187	BSV78	B141
BFY70	B105	BPX71	A135	BSV79	B141
BFY90	B87	BPY10	A136	BSV80	B141
BLX13	B105	BPY20 to		BSV81	B142
BLX14	B105	BPY24	A187	BSV86	B122
BLX65	B106	BPY51		BSV87	B122
BLX66	B105	to		BSV88	B122
BLX67	B106	BPY57	A187	BSV96	B123
BLX68	B106	BPY58	A187	BSV97	B123
BLX69	B106	BPY59	A187	BSV98	B123

BSW41	B123	BU108	B113	BYX39 series	B38
BSW66	B123	BU126	B114	BYX40 series	B38
BSW67	B123	BU132	B114	BYX42 series	B38
BSW68	B123	BU133	B114	BYX45 series	B38
BSW69	B124	BU204	B115	BYX46 series	B38
BSX12	B124	BU205	B115	BYX48 series	B39
BSX12A	B124	BU206	B115	BYX49 series	B39
BSX19	B124	BU207	B115	BYX50 series	B39
BSX20	B125	BU208	B115	BYX52 series	B39
BSX21	B125	BU209	B115	BYX55 series	B39
BSX59	B125	BXY27	B19	BYX56 series	B40
BSX60	B125	BXY28	B19	BYX59 series	B40
BSX61	B126	BXY29	B19	BYX71 series	B40
BSY38	B126	BXY32	B19	BZW86 series	B31
BSY39	B126	BY126	B34	BZW91 series	B32
BT100A series	B42	BY127	B34	BZW93 series	B33
BT101 series	B42	BY164	B50	BZX48	B22
BT102 series	B42	BY176	B34	BZX49	B22
BTW23 series	B43	BY179	B50	BZX50	B22
BTW24 series	B43	BY184	B35	BZX61 series	B22
BTW30 series	B44	BY185	B35	BZX70 series	B23
BTW31 series	B44	BY187	B35	BZX75 series	B23
BTW32 series	B44	BY188A	B36	BZX79 series	B24
BTW33 series	B45	BY188B	B36	BZX84 series	B152
BTW34 series	B45	BY206	B36	BZX90	B24
BTW47 series	B45	BYX10	B35	BZX91	B24
BTW92 series	B46	BYX13 series	B35	BZX92	B24
BTX18 series	B46	BYX22 series	B35	BZX93	B24
BTX41 series	B46	BYX25 series	B36	BZY78	B25
BTX94 series	B47	BYX29 series	B36	BZY88 series	B25
BTX95 series	B47	BYX30 series	B37	BZY91 series	B26
BTY79 series	B48	BYX32 series	B37	BZY93 series	B26
BTY87 series	B48	BYX35	B37	BZY95 series	B27
BTY91 series	B48	BYX36 series	B37	BZY96 series	B27
BU105	B113	BYX38 series	B37		

BZZ14		D13-16..	A68	DCT61	C18
to		D13-16../01	A68	DCX4/1000	A153
BZZ29	B28	D13-19	A68	DCX4/5000	A153
C3J	A161	D13-21..	A69	DF61N	A45
C3JA	A161	D13-26..	A69	DF66	A45
C3m	A44	D13-26../01	A69	DF67	A45
CAY10	B20	D13-27GH	A69	DG7-5	A71
CM20	C38	D13-450GH/01	A70	DG7-6	A71
CP16 series	C138	D13-480..	A70	DG7-31	A72
CP23 series	C141	D13-481..	A70	DG7-32	A72
CQY11B	A137	D13-500GH/01	A70	DG7-36	A72
CR16	C112	D14-120..	A70	DG10-6	A73
CR25	C112	D14-121..	A71	DG10-74	A73
CR37	C112	D14-122..	A71	DG13-2	A73
CR52	C112	D14-123..	A71	DG13-32	A73
CR68	C112	D14-160../09	A71	DG13-34	A74
CR93	C112	D18-120..	A71	DH3-91	A71
CSA70	C10	DC70	A44	DH7-11	A72
CRY201 to		DCA3	C4	DH7-78	A72
CRY204	A187	DCA10	C7	DH10-78	A73
CSPD	C25	DCD50	C14	DL20	C227
CXY10	B20	DCG1/250	A150	DL50	C228
CXY11A	B20	DCG4/1000ED	A150	DL51	C228
CXY11B	B21	DCG4/1000G	A150	DL53	C229
CXY11C	B21	DCG4/5000	A151	DL55	C230
CXY12	B21	DCG5/5000EG	A151	DL64	A45
D3a	A44	DCG5/5000GB	A151	DL66	A45
D7-190..	A67	DCG5/5000GS	A151	DL68	A46
D10-11..	A67	DCG6/18	A151	DL96	A2
D10-12..	A67	DCG6/18GB	A151	DM70	A2
D10-160..	A67	DCG6/6000	A152	DM71	A3
D10-161..	A67	DCG7/100	A152	DM160	A46
D10-170GH	A67	DCG7/100B	A152	DN7-11	A72
D10-200GH/07	A68	DCG9/20	A152	DN7-36	A72
D13-15..	A68	DCG12/30	A153	DN7-78	A72

DN10-78	A73	E81L	A47	EBF83	A5
DOA40	C10	E82CC	A47	EBF89	A6
DOA42	C10	E83CC	A48	EBL21	A6
DOA61	C18	E83F	A48	EC55	A127
DP7-5	A71	E84L	A48	EC80	A53
DP7-6	A71	E86C	A49	EC81	A54
DP7-11	A72	E88C	A49	EC86	A6
DP7-78	A72	E88CC	A49	EC88	A6
DP10-6	A73	E90CC	A49	EC90	A54
DP10-74	A73	E90F	A49	EC91	A54
DP10-78	A73	E92CC	A50	EC92	A6
DP13-2	A73	E99F	A50	EC97	A7
DP13-34	A74	E130L	A50	EC157	A127
DX206	A122	E180CC	A51	EC158	A128
DY51	A3	E180F	A51	EC900	A7
DY86	A3	E182CC	A51	EC1000	A54
DY87	A3	E186F	A51	EC8010	A55
DY802	A3	E188CC	A52	ECC40	A7
DZD40	C11	E235L	A52	ECC81	A7
E1T	A192	E236L	A52	ECC82	A7
E10-12..	A74	E280F	A52	ECC83	A8
E10-130..	A74	E282F	A53	ECC84	A8
E13/7/3	C250	E283CC	A53	ECC85	A8
E14-100..	A74	E288CC	A53	ECC86	A8
E20/10/5	C250	E810F	A53	ECC88	A8
E30/15/7	C250	EA52	A127	ECC186	A55
E42/21/15	C250	EA53	A127	ECC189	A8
E55/28/21	C250	EA76	A46	ECC2000	A55
E55L	A46	EAA91	A3	ECF80	A9
E65/32/13	C250	EABC80	A4	ECF86	A9
E80CC	A46	EAF41	A4	ECF200	A9
E80CF	A47	EAF42	A4	ECF201	A9
E80F	A47	EBC41	A5	ECF801	A9
E80L	A47	EBC81	A5	ECF802	A9
E80T	A192	EBF80	A5	ECH21	A9

ECH42	A10	EL42	A18	F046	C57
ECH81	A10	EL81	A18	F047	C58
ECH83	A11	EL82	A18	F048	C66
ECH84	A11	EL83	A18	F050	C59
ECH200	A11	EL84	A19	F051	C66
ECL80	A12	EL86	A19	F053	C60
ECL82	A12	EL91	A19	F054	C54
ECL84	A12	EL95	A20	F057	C64
ECL85	A12	EL360	A56	F058	C56
ECL86	A13	EL500	A20	F064	C61
ECL805	A12	EL503	A20	F066	C67
ED500	A13	EL504	A20	F088	C68
EF40	A13	EL508	A21	FCH101	B160
EF41	A13	EL509	A21	FCH111	B160
EF42	A13	EL519	A21	FCH121	B160
EF50	A55	EL802	A21	FCH131	B160
EF80	A14	ELC2000S	C196	FCH141	B160
EF83	A14	EM80	A21	FCH151	B160
EF85	A14	EM81	A21	FCH161	B160
EF86	A14	EM84	A21	FCH171	B160
EF89	A15	EM87	A22	FCH181	B160
EF91	A15	EPD	C23	FCH191	B160
EF92	A15	EPD60	C24	FCH201	B160
EF95	A15	EY51	A22	FCH211	B160
EF97	A15	EY81	A22	FCH221	B162
EF98	A16	EY82	A22	FCH231	B162
EF183	A16	EY86	A22	FCH281	B162
EF184	A16	EY87	A22	FCH291	B162
EFF51	A56	EY88	A22	FCH301	B162
EFL200	A16	EY500A	A23	FCH311	B162
EFP60	A56	EZ40	A23	FCH321	B162
EH90	A16	EZ41	A23	FCJ101	B164
EL34	A17	EZ80	A23	FCJ111	B164
EL36	A17	EZ81	A23	FCJ121	B164
EL41	A17	F045	C62	FCJ131	B164

FCJ141	B164	FDR131Z1	B202	FJY101/7460	B218
FCJ191	B164	FF3	C2	G40-25	A149
FCJ201	B164	FF4	C2	G40-50	A149
FCJ211	B164	FF10	C5	GA11	C6
FCK111	B166	FF11	C5	GLD60	C16
FCL101	B166	FF12	C5	GY501	A23
FCY101	B166	FF90	C19	GZ34	A24
FDH106	B170	FJH101/7430	B212	HPA60	C16
FDH116	B172	FJH111/7420	B212	ID10	C7
FDH126	B174	FJH121/7410	B212	IVSR	C22
FDH136	B176	FJH131/7400	B212	I42/7.5/15	C250
FDH146	B178	FJH141/7440	B212	JP8-02B	A116
FDH156	B180	FJH151/7450	B212	JP9-2.5D	A116
FDJ106	B182	FJH161/7451	B212	JP9-2.5E	A116
FDN106	B184	FJH171/7453	B214	JP9-7A	A116
FDN116	B184	FJH181/7454	B214	JP9-7D	A116
FDN126	B186	FJH191/7480	B214	JP9-15	A116
FDN136	B187	FJH221/7402	B214	JP9-15B	A116
FDN146	B188	FJH231/7401	B214	JP9-18	A117
FDN156	B189	FJH241/7404	B214	JP9-75	A117
FDN186	B190	FJH251/7405	B214	JPT9-01	A122
FDN206A	B191	FJH261/7442	B214	K50A	A128
FDN206B	B191	FJH291/7403	B214	K51A	A128
FDN216A	B192	FJJ101/7470	B216	K81A	A192
FDN216B	B192	FJJ111/7472	B216	KS9-20B	A124
FDN506	B193	FJJ121/7473	B216	KS9-20D	A124
FDN516	B193	FJJ131/7474	B216	KS9-40	A124
FDN536A	B194	FJJ141/7490	B216	KS9-40B	A124
FDN536B	B194	FJJ151/7491A	B216	KS9-40D	A124
FDQ106	B195	FJJ181/7475	B216	LB6-25	A126
FDR116Z...	B196	FJJ191/7476	B218	LIP1	C26
FDR116Z1	B196	FJJ211/7493	B218	LRD50	C13
FDR126Z...	B200	FJJ251/7492	B218	LSU60	C20
FDR126Z1	B200	FJJ261/74107	B218	M17-140W	A83
FDR131Z...	B202	FJL101/7441	B218	M17-141W	A83

M21-11W	A83	NIC50	C12	OSM9210 series	B51
M21-12W	A83	OA2	A167	OSM9310	B52
M24-100W	A83	OA2WA	A167	OSM9410 series	B52
M24-101W	A83	OA47	B11	OSS9110 series	B51
M28-12W	A84	OA90	B11	OSS9210 series	B51
M31-120W	A84	OA91	B11	OSS9310 series	B52
M31-130W	A84	OA95	B11	OSS9410	B52
M36-11W	A84	OA200	B11	OTH1200 series	B49
M36-16W	A84	OA202	B12	P1ACC../...	C34
M38-120W	A85	OAP12	A136	P1FCB../...	C34
M38-121W	A85	OB2	A167	P1HCB../...	C33
MC13-16	A85	OB2WA	A167	P1RB../...	C33
MF0.5A	C21	OC139	B126	P3ACC../...	C34
MF2A	C21	OC140	B127	P3FCB../...	C34
MG13-38	A85	OC141	B127	P3HCB../...	C33
MID50	C12	OCP70	A137	P3RB../...	C33
MK13-16	A85	OM200	B224	P9/5	C242
MPD	C25	ORP10	A137	P11/7	C242
MR24	C117	ORP13	A137	P14/8	C242
MR24C/D/E	C118	ORP30N	A132	P18/11	C242
MR25	C115	ORP50	A132	P22/13	C242
MR30	C115	ORP52	A132	P26/16	C242
MR31	C121	ORP60	A132	P30/19	C242
MR34	C117	ORP61	A132	P36/22	C242
MR34C/D/E	C119	ORP62	A133	P42/29	C242
MR39	C121	ORP63	A133	PA1	C3
MR52	C115	ORP69	A133	PA10	C7
MR54	C117	ORP90	A133	PA60	C16
MR54C/D/E	C119	OS2	C3	PAA1	C3
MR58	C121	OS11	C6	PAA10	C7
MR74C/D/E	C119	OSB9110 series	B51	PABC80	A24
MR81	C121	OSB9210 series	B51	PC86	A24
MU13-38	A85	OSB9310 series	B52	PC88	A24
MW13-38	A85	OSB9410 series	B52	PC92	A24
MY13-38	A85	OSM9110 series	B51	PC97	A25

PC900	A25	PL82	A32	PS1011	A182
PCC85	A25	PL83	A32	PS1012	A182
PCC88	A25	PL84	A32	PS1013	A182
PCC189	A25	PL95	A32	PS1014	A182
PCF80	A26	PL105	A159	PS1014SF	A182
PCF86	A26	PL106	A159	PS1520	A182
PCF200	A27	PL150	A159	PS1521	A182
PCF201	A27	PL255	A159	PS1531	A183
PCF801	A28	PL260	A160	PS2010/50	A183
PCF802	A28	PL500	A32	PS2010/100	A183
PCH200	A29	PL504	A33	PS5302	A182
PCL82	A29	PL505	A33	PS5400	A184
PCL84	A29	PL508	A33	PS5410	A184
PCL85	A30	PL509	A33	PSM40	C11
PCL86	A30	PL519	A34	PSR50	C13
PCL805	A30	PL802	A34	PSU60	C20
PD1	C3	PL1607	A160	PSU61	C20
PD11	C6	PL5544	A160	PWB63	C17
PD500	A30	PL5545	A160	PY81	A34
PD510	A30	PL5555	A176	PY82	A34
PDA1	C3	PL5557	A161	PY88	A35
PDU50A	C14	PL5559	A161	PY500	A35
PDU50B	C14	PL5632	A161	PY500A	A35
PE05/25	A99	PL5684	A161	Q13-110..	A85
PE06/40E	A99	PL5727	A161	QB2/250	A100
PE06/40N	A99	PL6574	A162	QB3/200	A100
PE06/40P	A99	PL6755A	A162	QB3/300	A100
PE1/100	A99	PM84	A34	QB3/300GA	A100
PF86	A31	PR1	C3	QB3.5/750	A100
PEL200	A31	PR37	C123	QB3.5/750GA	A100
PL2D21	A159	PR52	C123	QB4/1100	A101
PL3C23A	A159	PS2	C3	QB4/1100GA	A101
PL10	A159	PS10	C6	QB5/1750	A101
PL36	A31	PS90	C19	QB5/2000	A101
PL81	A31	PS1010	A182	QBL3.5/2000	A101

QBL4/800	A101	RPY13	A133	TAA522	B228
QBL5/3500	A101	RPY18	A133	TAA550	B234
QBW5/3500	A102	RPY19	A133	TAA560	B224
QC05/35	A102	RPY20	A134	TAA570	B234
QE03/10	A102	RPY27	A134	TAA580	B226
QE05/40	A102	RPY33	A134	TAA630	B235
QE05/40F	A103	RPY41	A134	TAA640	B243
QE05/40H	A103	RPY43	A134	TAA700	B234
QE05/40K	A103	PRY55	A134	TAA840	B230
QE08/200	A103	PRY58	A134	TAA960	B243
QE08/200H	A103	RPY71	A134	TAA970	B222
QEL1/150	A103	RPY76A	A137	TAB101	B242
QEL1/150H	A103	RSA61	C18	TAD100	B230
QEL2/200	A104	RSR10	C9	TAL12/10	A86
QEL2/275	A104	S5600	A185	TAL12/20	A86
QEL2/275H	A104	S5600/01	A185	TAL12/35	A86
QQC03/14	A104	S5600/02	A185	TAW12/10	A86
QQC04/15	A104	S5600/03	A185	TAW12/20	A87
QQE02/5	A105	SAM series	A181	TAW12/35G	A87
QQE03/12	A105	SID50	C12	TB2.5/300	A87
QQE03/20	A105	SIS series	A181	TB2.5/400	A87
QQE03/32	A105	SL109	A185	TB3/750	A87
QQE04/5	A105	SPF series	A181	TB4/1250	A87
QQE04/20	A105	SPH series	A181	TB4/1500	A88
QQE06/40	A106	SU50	C14	TB5/2500	A88
RD10	C7	TAA263	B220	TBA221	B228
RD11	C7	TAA293	B242	TBA222	B228
RI-12	A191	TAA300	B220	TBA281	B243
RI-20	A191	TAA310	B220	TBH6/14	A88
RIC50	C12	TAA320	B220	TBH6/6000	A88
RM4	C247	TAA350	B234	TBH7/8000	A88
RM5	C247	TAA370	B224	TBH7/9000	A88
RM6-R	C247	TAA435	B220	TBH12/25	A88
RM6-S	C247	TAA450	B234	TBH12/38	A88
RM8	C247	TAA521	B228	TBL2/300	A88

TBL2/400	A89	UCC85	A37	XA1003	A145
TBL2/500	A89	UCH21	A37	XL7900	A193
TBL6/14	A89	UCH42	A37	XP1000	A138
TBL6/20	A89	UCH81	A38	XP1001	A138
TBL6/4000	A89	UCL82	A38	XP1002	A138
TBL6/6000	A89	UF41	A39	XP1003	A138
TBL7/8000	A90	UF42	A39	XP1004	A138
TBL7/9000	A90	UF80	A39	XP1005	A138
TBL12/25	A90	UF85	A39	XP1006	A138
TBL12/38	A90	UF89	A39	XP1010	A138
TBL12/40	A90	UL41	A40	XP1011	A138
TBL12/100	A90	UL84	A40	XP1015	A138
TBL15/125	A91	UM84	A40	XP1016	A138
TBW6/14	A91	UMC60	C16	XP1020	A138
TBW6/6000	A91	UPA61	C18	XP1021	A138
TBW7/8000	A91	UY41	A41	XP1023	A138
TBW7/9000	A91	UY42	A41	XP1030	A139
TBW12/25	A91	UY82	A41	XP1031	A139
TBW12/38	A91	UY85	A41	XP1032	A139
TBW12/100	A91	UY89	A41	XP1033	A139
TBW15/125	A91	VSO	C22	XP1034	A139
TH71	A191	WR0617	C126	XP1040	A139
TH73	A191	WR0617E	C127	XP1041	A139
TH75	A191	WR0825	C126	XP1050	A184
TT60	C16	WR0825E	C127	XP1051	A184
TT61	C18	WR0842	C126	XP1052	A184
TU10	C6	WR0842E	C127	XP1053	A184
TU60	C16	WR0865	C126	XP1110	A139
TVHC40	A145	WR0865E	C127	XP1113	A140
UABC80	A35	X22	C252	XP1114	A140
UAF42	A36	X30	C252	XP1115	A140
UBC41	A36	X35	C252	XP1116	A140
UBC81	A36	XA1000	A145	XP1117	A140
UBF80	A37	XA1001	A145	XP1118	A140
UBF89	A37	XA1002	A145	XP1119	A140

XP1120	A144	XQ1024	A76	XQ1074/01R	A77
XP1121	A144	XQ1024R	A76	XQ1075	A77
XP1122	A144	XQ1025	A76	XQ1075R	A77
XP1123	A144	XQ1025L	A76	XQ1076	A77
XP1130	A144	XQ1025R	A76	XQ1076R	A77
XP1131	A144	XQ1026	A76	XQ1080 series	A78
XP1140	A140	XQ1026R	A76	XQ1081 series	A78
XP1141	A140	XQ1031	A81	XQ1090	A78
XP1143	A140	XQ1032	A81	XQ1091	A78
XP1180	A141	XQ1070	A76	XQ1100	A78
XP1190	A184	XQ1070/01	A76	XQ1101	A78
XP1191	A184	XQ1070B	A76	XQ1102	A78
XP1192	A184	XQ1070/01B	A76	XQ1220 series	A79
XP1193	A184	XQ1070G	A76	XQ1230 series	A79
XP1200	A184	XQ1070/01G	A76	XQ1240	A82
XP1210	A141	XQ1070L	A76	XQ1241	A82
XP1220	A141	XQ1070/01L	A76	XQ1270	A82
XP1230	A141	XQ1070R	A76	XQ1271	A82
XP2000	A141	XQ1070/01R	A76	XQ1272	A82
XP2020	A141	XQ1071	A77	YD1000	A91
XP2030	A141	XQ1071/01	A77	YD1001	A92
XQ1010	A81	XQ1071B	A77	YD1002	A92
XQ1020	A75	XQ1071/01B	A77	YD1010	A92
XQ1020B	A75	XQ1071G	A77	YD1012	A92
XQ1020G	A75	XQ1071/01G	A77	YD1050	A128
XQ1020L	A75	XQ1071R	A77	YD1051	A129
XQ1020R	A75	XQ1071/01R	A77	YD1120	A92
XQ1021	A75	XQ1072	A77	YD1130	A92
XQ1021B	A75	XQ1073	A77	YD1140	A93
XQ1021G	A75	XQ1073/01	A77	YD1141	A93
XQ1021R	A75	XQ1073R	A77	YD1150	A93
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